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AN EMPIRICAL ANALYSIS OF EFFICIENCY AND PRODUCTIVITY CHANGE IN THE GLOBAL AUTOMOTIVE INDUSTRY: A MALMQUIST PRODUCTIVITY INDEX APPROACH

A Master's Thesis

by

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Department of

Economics

Bilkent University

Ankara

April 2009

To My Family

AN EMPIRICAL ANALYSIS OF EFFICIENCY AND PRODUCTIVITY CHANGE IN THE GLOBAL AUTOMOTIVE INDUSTRY: A MALMQUIST PRODUCTIVITY INDEX APPROACH

The Institute of Economics and Social Sciences
of
Bilkent University

by

ÖZLEM YAYLACI

In Partial Fulfillment of the Requirements for the Degree of
MASTER OF ARTS

in

THE DEPARTMENT OF
ECONOMICS
BİLKENT UNIVERSITY
ANKARA

April 2009

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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ABSTRACT

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A MALMQUIST PRODUCTIVITY INDEX APPROACH

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April 2009

This thesis examines productivity changes in automotive sectors of 26 industrial and developing countries over the period 1973-2002. Using data envelopment analysis, Malmquist productivity change indices are computed and decomposed into technical change and efficiency change components. The results show that productivity improvements by the industrial countries were attained through technical change while productivity gains of developing countries mainly arose from efficiency change. It is found that the performance of Turkey was similar to the average of developing countries showing a better performance in catching-up effect. Moreover, for the countries in the sample, automotive sector labor productivity changes are calculated. Comparing the labor productivity change and Malmquist change rankings of the countries, it is concluded that the best performer countries in terms of labor productivity change are also the best performers in terms of Malmquist productivity change index.

Keywords: Automotive Sector, Efficiency Change, Productivity Change, Malmquist Index

ÖZET

GLOBAL OTOMOTIV SANAYIINDE ETKINLIK
VE VERIMLILIK DEGISIMI UZERINE EMPIRIK BIR ANALIZ:
MALMQUIST VERIMLILIK ENDEKSI YAKLASIMI

Yaylacı, Özlem
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Tez Danışmanı: Doç. Dr. Fatma Taşkın

Nisan 2009

Bu tez, sanayileşmiş ve gelişmekte olan 26 ülkenin otomotiv sektörlerinde 1973-2002 periyodundaki verimlilik değişimlerini incelemektedir. Veri zarflama analizi kullanılarak Malmquist verimlilik değişim endeksleri hesaplanmiş, teknik değişim ve etkinlik değişimi bileşenlerine ayrılmıştır. Sonuçlar göstermektedir ki, gelişmekte olan ülkelerdeki verimlilik kazanımları büyük ölçüde etkinlik değişiminden kaynaklanırken sanayileşmis ülkelerdeki verimlilik gelişmeleri teknik değişim yoluyla kazanılmıştır. Türkiye'nin, gelişmekte olan ülkelerin ortalama performansına benzer olarak, yakalama etkisinde daha iyi bir performans gösterdiği bulunmuştur. Ayrica, örneklemdeki ülkeler için, otomotiv sektörü işci verimlilik değişimleri hesaplanmıştır. Ülkelerin işçi verimlilik değişim ve Malmquist değişim sıralamaları karşılaştırıldığında işçi verimlilik değişiminde en iyi performansi gösteren ülkelerin aynı zamanda Malmquist verimlilik değişimi endeksinde de en iyi performansi gösterdikleri sonucuna varılmıştır.

Anahtar Kelimeler: Otomotiv Sektörü, Etkinlik Değişimi, Verimlilik Değişimi, Malmquist Endeksi

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TABLE OF CONTENTS

APPENDICES

CHAPTER I

INTRODUCTION

An increase in productivity results with improvements in service and quality, decrements in production cost and increments in profit and market share. Hence, productivity measurement is the major tool of monitoring the performance of a firm, a country or an industry. Understanding the productivity changes of a sector can help countries determine where they can improve their performances, which can not be seen by revenue and profit reports since these reports only show the end of production results and not the performance in the process of production. So, if countries can understand the reasons behind productivity changes, they can find ways to improve their productivity.

Automotive manufacturing sector is one of the major industries in many countries, both in terms of the total value of production, and in terms of international trade and its contributions to the economies, with its backward and forward linkages. The severe international competition among the major producers is now coupled with the increasing globalization of the production process, including more developing countries in the production chain.

In this important sector, a performance analysis is necessary to identify the changes in the relative positions of producers and underlying factors that lead to these changes. Although considerable empirical work has already been undertaken with respect to the individual country or region specific automotive sector productivity analysis, we do not know any empirical work on cross country comparisons in the global automotive sector productivity. So the motivation for this study occurs from the need to find the productivity change differences in automotive industries of industrial and developing countries in the world.

The purpose of this study is, using non-parametric linear programming techniques, to examine and compare the productivity changes among the automotive industries of 26 countries which include industrial and developing countries. Our main interests can be summarized as follows:

(1) What are the sources of change in automotive sector productivity for industrial and developing country groups? Is it due to the development of better techniques of production, which is referred as technical change or is it due to the better use of factor of production mix, referred to efficiency change?

(2) Are there significant differences between automotive sector productivity patterns of industrial countries and developing countries?

(3) Do the best performer countries in terms of productivity changes show significant variations through the years or does their productivity performance always stay the same?

(4) Can we see the effects of changes occurring in production and export patterns of developing countries in their productivity performances?

(5) Does the Malmquist Productivity Change Index, a total factor productivity measure that takes the best use of all factors of production into consideration, provide additional insights to the conclusions derived from the partial productivity change measures such as labor productivity? The automotive producers' performance will be evaluated according to these two alternative measures of productivity.

(6) What is the main source of Turkish automotive sector productivity change and how does Turkey compare to the countries included into the sample in terms of its productivity changes in this sector?

Employing Malmquist Productivity Change Index, productivity growth is decomposed into efficiency change and technical change, namely 'catching up' and 'innovation' components, respectively. Hence, Malmquist index distinguishes explicitly between the sources of growth (either from efficiency change or technical change), so it is superior to alternative indices of TFP growth. Moreover, Malmquist index computation does not require any information on input-output prices since it is based only on quantity data, and does not require an underlying functional form specification about technology, all of which justify our use of this index as the methodology of computing productivity changes.

Using Malmquist index, we compare each country in the sample to a world production frontier of automotive sector constructed from the data defined at the three-digit level of the International Standard Industrial Classification (ISIC), a data set that includes sector level information on individual country productions. Our findings show that the productivity gains of developing

countries are largely attributable to efficiency change, and productivity improvements of industrial countries mainly arise from technical change.

This paper is organized as follows; in Chapter 2 we describe the structure of the automotive sector with a special emphasis on Turkish automotive sector. Chapter 3 presents a literature review on the methodology used to calculate the productivity changes, and Chapter 4 explains the theoretical framework supporting the model used. We present the data source and the output and input specifications in Chapter 5. Chapter 6 reports and interprets the empirical results, and finally Chapter 7 gives suggestions for future research and concludes.

CHAPTER II

AUTOMOTIVE SECTOR

The automotive sector, defined as motor vehicles, parts, and accessories , is one of the most important sectors for the world economy in terms of its effects on the economic growth of countries. The industry fosters GDP growth, provides employment and increases export values in the manufacturing sector. With all these and many other effects on the economy, the sector is a major contributor to the economic welfare of countries. Traditionally, being a producer in the automotive sector is perceived as an indicator of economic development for most countries.

The sector is also a major contributor to world production. According to the International Organization of Motor Vehicle Manufacturers, OICA, if it had been a country, its total production would be equivalent to the world's sixth largest economy. To understand the importance of the automotive sector to the global economy, it is helpful to look at its relative position with respect to other sectors. For this purpose, we calculated the sectoral production, employment, and export shares of total world manufacturing using data from the United Nations Industrial Development Organization (UNIDO). Although this is the

data set covering the most up-to-date information about sectoral production, employment, and export patterns, it is very difficult to find comparable cross-country sector level production data for all countries; for some countries and some sectors, data are not available.

After eliminating four sectors in the dataset[1] for which data are not available for the majority of the countries, and choosing countries according to the availability of data, we compared 24 sectors and 26 countries with respect to their production, employment, and export shares in total manufacturing. Since 1981 is the earliest and 2000 is the latest year for which data are available at a three-digit ISIC sector level, we present our analyses for the years 1981, 1990, and 2000, to give an idea of the evolution of the sector through the years.

2.1. Contributions to Manufacturing Production

The importance of automotive sector production can be assessed by looking at the production shares of all industries in total manufacturing sector production. Shares are computed by comparing the value added generated by each sector and are reported in Table 1. In our analyses, the automotive sector is represented by the "Transport Equipment" sector (sector code: 384) since the majority of transport equipment data covers automotive-related manufacturing. The names of other sectors with their ISIC codes are presented in the Appendix A.

[1] We eliminated "Petroleum Refineries", "Misc. Petroleum and Coal Products", "Pottery, China, Earthenware" and "Non-Ferrous Metals" sectors which are represented by the ISIC codes 353, 354, 361, and 372, respectively. Values of these sectors, whenever available, are included under the sector name of "Others."

Table 1: Sectoral Production Shares in Total Manufacturing

Sector	1981(%)	Rank	1990(%)	Rank	2000(%)	Rank
311	8.29	4	8.43	4	9.50	4
313	2.22	15	1.92	15	1.97	16
314	1.07	21	1.35	18	1.44	19
321	3.82	10	3.18	11	2.47	14
322	2.26	14	1.80	16	1.47	18
323	0.32	24	0.26	24	0.25	24
324	0.51	23	0.33	23	0.28	23
331	1.76	17	1.64	17	1.87	17
332	1.41	18	1.33	19	2.05	15
341	3.41	11	3.48	10	3.78	10
342	4.88	6	5.68	6	3.10	11
351	4.86	7	5.18	8	4.27	7
352	4.69	9	5.44	7	7.16	6
355	1.25	20	1.21	21	1.13	21
356	2.13	16	2.95	12	3.84	9
362	0.94	22	0.89	22	0.89	22
369	2.80	12	2.63	14	2.70	13
371	4.85	8	3.79	9	2.84	12
381	6.61	5	6.24	5	7.74	5
382	12.23	1	11.85	1	11.40	3
383	9.95	3	10.78	3	12.91	1
384	**10.36**	**2**	**11.05**	**2**	**11.49**	**2**
385	2.37	13	2.79	13	3.92	8
390	1.33	19	1.25	20	1.42	20
Others	5.57		4.40		3.30	
Total	100		100		100	

Source: UNIDO INDSTAT3 rev.2, 2006.

Figures indicate that in 1981, the automotive sector had a share of 10.36% of total manufacturing production and in 1990, its share increased to 11.05%. With this share, the automotive industry is ranked as the second largest sector following "Machinery, Except Electrical" in both years. In 2000, the share reached 11.49% of total manufacturing production[2]. All through the period from 1981 to 2002, the automotive sector is ranked as the second largest in total

[2] Since data are not available for Western Germany, Greece, Netherlands, Zimbabwe, Denmark, and Venezuela in year 2000, total manufacturing figures are calculated using the data of remaining 20 countries in that year.

manufacturing production with an increasing share. This emphasizes the growing importance of the automotive sector in manufacturing production.

If we examine countries individually, for more than half of them, the share earned by the automotive sector is ranked within the top five largest sectors in total manufacturing production in 2000[3]. This rank was even higher for Japan, USA, the UK, France and Spain, which are the countries traditionally dominating the sector with higher production and export levels. Their automotive sectors are in the top three of manufacturing production for 2000.

In the case of Turkey, the automotive sector is ranked as the fifth largest in 1981, with a share of 4.7% of total manufacturing production. In 1990, the sector is ranked as third, increasing its share to 6%. In 2000, after "Food Products" the automotive sector is ranked as the second largest with a share of 8.4% of total manufacturing production. This illustrates the significance of the sector for Turkey's production.

To give a better understanding of the structure of the sector, we examine the leading producers in the sector. Table 2 shows shares of countries and country groups[4] in world automotive production for the years 1981, 1990, and 2000, sorted from largest to smallest share in 2000.

[3] Country production shares and rankings of the sectors in total manufacturing for the years 1981, 1990, and 2000 are presented in tables 1, 2, and 3 of Appendix A, respectively.

[4] Following the International Monetary Fund (IMF) World Economic Outlook, May 1993, we divided countries into industrial and developing country groups. Poland is considered a developing country although it is classified in the "countries in transition" group in the report.

Table 2: Country Shares in World Automotive Production

COUNTRY	**1981 (%)**	**1990 (%)**	**2000 (%)**
USA	39.88	34.53	40.34
JAPAN	16.89	21.43	19.25
GERMANY[5]	13.19	15.11	14.21
FRANCE	6.94	6.41	4.32
UK	7.16	6.49	4.16
CANADA	3.00	3.16	4.05
ITALY	4.14	3.26	2.02
SPAIN	1.64	2.31	1.58
SWEDEN	1.50	1.44	1.02
NETHERLANDS	0.60	0.55	0.49
NORWAY	0.41	0.23	0.40
AUSTRIA	0.28	0.37	0.38
PORTUGAL	0.14	0.13	0.20
DENMARK	0.27	0.25	0.14
GREECE	0.21	0.10	0.12
FINLAND	0.36	0.31	0.11
Total Industrial	**96.70**	**96.10**	**92.80**
KOREA	0.71	2.29	5.08
TURKEY	**0.27**	**0.39**	**0.62**
INDIA	0.57	0.53	0.55
POLAND	0.89	0.41	0.42
HUNGARY	0.23	0.08	0.24
VENEZUELA	0.33	0.04	0.13
CHILE	0.08	0.03	0.06
COLOMBIA	0.12	0.07	0.04
ZIMBABWE	0.02	0.01	0.02
ECUADOR	0.01	0.004	0.00
Total Developing	**3.30**	**3.90**	**7.20**
Total	**100**	**100**	**100**

Source: UNIDO INDSTAT3 rev.2, 2006.

According to the table, USA, Japan and Germany are the leading producers in the automotive sector. USA especially had a very important role in the sector production with a share of exceeding 40% of the world's automotive production in 2000. Note that all the big producers in the automotive sector are

[5] Germany refers to the Western Germany for all the analyses in this thesis.

high-income countries such as France, the UK, Italy and Spain. This explains why the sector is considered as an indicator of economic development. In addition, the sector is composed of a few large producers, which leads to an oligopolistic market structure. Although the sector is highly competitive and usually controlled by the countries that have technological and financial power, some developing countries in our sample, like Korea, Turkey, and Hungary, also showed very important improvements in the sector over the last decades.

Turkey showed considerable improvement and increased its world market share to 0.62% in 2000 from 0.27% in 1981. Improvement that is more significant is seen in Korea, which increased its share of world production sevenfold. By these improvements, the share of developing countries of total automotive production increased through the years and in 2000, this group of countries had a share of 7.2% of total automotive production, which is more than double the share of 1981. One of the main reasons for this increase in share is the foreign facilities of the automotive firms. These facilities make the connection between developed and developing countries and give the developing countries the opportunity to utilize new technologies originated in industrial countries. Now, since every country has access to new production technologies, an innovation made in one country can be almost simultaneously adopted by every country in the world; the technological advantage of the older producers is not a large distinction any longer. Therefore, despite strong competition, some countries relatively new to automotive production, such as Korea, Turkey, Poland and India, show a presence in the market.

On the other hand, some of the traditionally larger producing countries have experienced decrease in their share of world production. For example, France, Italy, Spain, the UK, Denmark, Finland, and Sweden, all had decreases in their share of world automotive production in 2000 compared to 1981.

2.2. Contributions to Manufacturing Employment

It is important to examine the employment created in the automotive sector. The industry generates employment opportunities for the manufacturers, dealers, retailers, engineers, and electricians in the automotive sector. In addition, employment is created in related sectors, such as advertising, carpeting, textiles, computer chips, rubber, glass, lead, iron, steel, recycling, fuel, and others. Including related industries, it is estimated that each direct position in the automotive sector supports at least another five indirect jobs in related manufacturing and service industries.

The automotive sector is one of the major industries in most countries in terms of its share of employment. In the years included in the analysis, the sector accounted for approximately 10% of the total employment in all manufacturing. Table 3 shows employment shares of the sectors in total manufacturing employment.

Table 3: Sectoral Employment Shares in Total Manufacturing

Sector	1981(%)	Rank	1990(%)	Rank	2000(%)	Rank
311	9.58	4	9.87	4	11.76	1
313	1.25	20	1.09	20	1.07	20
314	0.90	23	0.86	23	0.98	21
321	8.24	5	7.23	5	5.94	6
322	4.53	8	4.29	8	4.07	8
323	0.55	24	0.50	24	0.48	24
324	1.05	21	0.92	21	0.92	22
331	2.50	14	2.37	15	2.78	16
332	1.94	17	2.00	17	3.05	11
341	2.80	13	2.73	13	2.81	14
342	4.37	9	5.19	7	3.21	10
351	2.81	12	2.67	14	2.24	17
352	2.90	10	3.13	11	3.73	9
355	1.43	19	1.53	19	1.27	19
356	2.30	15	3.20	10	4.28	7
362	0.97	22	0.89	22	0.86	23
369	2.87	11	2.80	12	3.03	12
371	4.98	7	3.59	9	2.80	15
381	6.86	6	7.08	6	9.27	3
382	11.02	1	11.10	1	10.31	2
383	9.87	3	10.33	2	9.18	4
384	**9.89**	**2**	**9.95**	**3**	**8.98**	**5**
385	1.97	16	2.35	16	2.94	13
390	1.66	18	1.67	18	1.74	18
Others	2.62		2.54		2.18	
Total	100		100		100	

Source: UNIDO INDSTAT3 rev.2, 2006.

The table shows that approximately 9.9% of total manufacturing employment is situated in the automotive sector in 1981. With this share, the automotive sector is ranked second after "Machinery, Except Electrical." In 1990, although its rank declined to third, the share of the automotive sector in total manufacturing employment increased slightly to 9.95%. In 2000, it is ranked fifth with a small decline both in share and in rank, and captured 8.98% of total manufacturing employment.

Country-by-country results reveal the contribution of the sector to the employment levels of the countries.[6] Data show that, in 2000, for more than half of the countries, the automotive sector is among the top five sectors with the largest employment shares.

Since the automotive sector is an industry which is very open to technological changes, this decline in total employment share, which is accompanied by a small increase in production share, may be the result of labor-saving technological changes in automotive production. By comparing Tables 4, 5, and 6 in Appendix A, we can conclude that country-by-country results also support this idea; among the individual countries, the technologically-leading countries of the world, such as USA, the UK, France, Italy, and Spain, have also experienced declines in share of employment in the automotive sector. The emerging markets of the sector, such as Korea, Turkey, India, and some of the formerly communist countries, Hungary and Poland, also have experienced declines in the employment share of the automotive sector with an increase in production share.

2.3. Contributions to Manufacturing Exports

International trade is another area where the importance of the automotive sector can be seen easily. Furthermore, recent changes in the world division of labor can be traced to changes in exports.

[6] The detailed employment analyses for each country for the years 1981, 1990, and 2000 can be found in Tables 4, 5, and 6 of Appendix A, respectively.

Table 4 shows that, in 1981, the automotive industry captured a 20.37% share of world manufacturing exports. In 1990, it showed an increase and achieved a 21% share in total manufacturing exports. In 2000, although it showed a decrease and declined to 18.79%, for all three years, the sector is ranked first in total manufacturing exports in the world.

The contribution of the industry to the export levels of countries cannot be underestimated. For more than half of the countries in the sample, the automotive sector export share is in the top three of total manufacturing exports.[7]

For Turkey, in 1981, the sector is ranked fifth with a share of 5.6% of the country's total manufacturing exports. In 1990, the share of the sector increased to 8.9% and it is ranked first. Table 9 in Appendix A shows that in 2000, with a share of 10.7%, it is ranked as the third sector in Turkish total manufacturing exports after the "Textiles" and "Wearing Apparel, Except Footwear" sectors. These increasing export shares show the growing impact of the sector on the Turkish economy. Founded as a montage industry in the beginning of the 1960s, according to Taskin (2004), the sector was able to export only 2% of its production by 1993. But today, the industry is one of the driving forces of the Turkish economy given its export levels.

[7] Export shares and rankings of the sectors in total manufacturing of the countries for the years 1981, 1990, and 2000 are presented in tables 7, 8, and 9 of Appendix A, respectively. Since the export data are not available for Hungary and Poland in all three years, for Zimbabwe in 1981 and 2000, and for Germany in 2000, total export values are calculated using the data of remaining countries.

Table 4: Sectoral Export Shares in Total Manufacturing

Sector	1981(%)	Rank	1990(%)	Rank	2000(%)	Rank
311	6.23	6	4.56	5	3.30	8
313	1.00	17	1.06	17	0.87	18
314	0.35	24	0.52	23	0.32	24
321	4.60	7	4.05	7	3.38	7
322	1.41	14	1.97	12	1.57	13
323	0.45	23	0.52	23	0.49	23
324	0.68	21	0.73	21	0.52	22
331	1.43	13	1.36	14	1.16	14
332	0.74	20	1.00	19	0.97	17
341	3.57	9	3.62	8	2.82	9
342	0.79	19	0.93	20	0.73	20
351	8.88	4	8.78	4	7.28	4
352	2.89	11	3.38	10	3.98	6
355	1.25	15	1.15	16	1.03	16
356	0.83	18	1.29	15	1.11	15
362	0.62	22	0.70	22	0.55	21
369	1.17	16	1.02	18	0.76	19
371	6.63	5	4.13	6	2.70	11
381	4.05	8	3.54	9	2.79	10
382	17.35	2	18.48	2	17.23	3
383	9.38	3	11.96	3	17.58	2
384	**20.37**	**1**	**21.00**	**1**	**18.79**	**1**
385	3.41	10	2.72	11	4.27	5
390	1.80	12	1.41	13	1.78	12
Others	5.22		2.66		3.90	
Total	100		100		100	

Source: UNIDO IDSB 2007.

Table 5, which presents the export shares of total automotive exports for the countries in our sample, shows that the largest share of automotive exports belongs to Japan, with 24%, and the second largest is USA with 21%. This is followed by West Germany, with 18% in 1981. Even though by the year 2000, USA and Japan changed rankings, the same three countries continued to be the three major exporters among automotive producers. The industrial countries in the sample account for 98.6 % of total exports in 1981 and 94.5% in 2000. In the

same period, the share of the developing countries in our sample increased from 1.4% to 5.5% showing a fourfold improvement.

Table 5: Country Shares in World Automotive Exports

COUNTRY	**1981 (%)**	**1990 (%)**	**2000 (%)**
USA	20.91	19.20	23.55
JAPAN	24.29	19.37	20.78
CANADA	7.29	8.68	13.26
FRANCE	8.90	10.03	11.68
UK	6.89	5.32	6.71
SPAIN	1.50	3.36	5.70
ITALY	4.37	5.01	5.26
NETHERLANDS	1.57	0.24	2.23
AUSTRIA	0.46	0.79	1.67
SWEDEN	2.72	2.32	1.64
PORTUGAL	0.08	0.32	0.69
FINLAND	0.59	0.55	0.52
NORWAY	0.64	0.52	0.37
DENMARK	0.57	0.36	0.36
GREECE	0.03	0.02	0.05
GERMANY	17.74	22.02	Na
Total Industrial	**98.60**	**98.10**	**94.50**
KOREA	1.07	1.65	4.67
TURKEY	**0.07**	**0.064**	**0.48**
INDIA	0.15	0.13	0.22
CHILE	0.04	0.009	0.05
COLOMBIA	0.01	0.003	0.05
VENEZUELA	0.03	0.01	0.04
ECUADOR	0.000	0.000	0.01
ZIMBABWE	Na	0.000	Na
POLAND	Na	Na	Na
HUNGARY	Na	Na	Na
Total Developing	**1.40**	**1.90**	**5.50**
Total	**100**	**100**	**100**

Source: UNIDO IDSB 2007.

Export share results parallel those of production results. Again, USA, Japan, and Germany are the leading countries in world automotive exports. The other big exporters are the UK, France, Italy, Canada and Spain. All developing

countries increased their export shares in 2000, as compared to 1990. Among developing countries, Turkey has the second largest share after Korea in total automotive exports, with an increasing trend through the years. In 2000, Turkey achieved a 0.48% share of total automotive exports and this was more than seven times the share in 1990. Additionally, Korea experienced a huge increase in export share, from 1.65% in 1990 to 4.67% in 2000. This shows that emerging countries have started to compete with the large producers in the industry.

Results of the analyses show the importance of the sector both for the global economy and for the individual countries. Sectoral comparisons indicate that the sector is one of the largest industries in the world in terms of its employment, production, and export levels.

Country-based results show the automotive industry to be dominated by a few countries. But the emerging countries have started to have a presence in the global automotive market in the last years with their production and export shares. If they continue to make technological and strategic connections with the leading countries in the sector, they can increase their importance and weight in the global market.

CHAPTER III

LITERATURE REVIEW

3.1. Productivity Literature

In this chapter, we give a literature review on the methodology we use to compute productivity changes, namely the Malmquist Productivity Change Index, based on Data Envelopment Analysis (DEA), and explain the reasons for choosing this approach.

Productivity is a very important indicator for the economic improvement of a country or a sector. Especially for a sector like automotive, whose contributions to the economy cannot be underestimated, productivity analysis is necessary. But surprisingly little research has been done on automotive sector productivity analysis.

Since there is no research investigating cross-country differences in the automotive sector on a global level, this paper intends to fill this void by using a productivity change method that we believe is the best.

In the productivity literature, there are two main approaches for measuring productivity growth: partial factor productivity measures, and total factor productivity measures. Partial factor productivity measures, such as labor

productivity (output per unit of labor input) and capital productivity (output per unit of capital input) are although commonly used in the productivity literature, they are, as the names suggest, only partial indices and thus can give misleading interpretations for overall productivity level. For example, labor productivity is affected by other inputs in production. Changes in capital input or intermediate inputs also affect the labor productivity. Hence, a productivity measure involving all factors of production, namely total factor productivity (TFP), is a more reliable measure of productivity.

The first approach to calculating TFP is the parametric method based on the estimation of some function, such as a production or cost function, and the second approach is based on the construction of an index number using non-parametric methods. Since the first approach requires imposition of a functional form for production technology, which is a strong assumption, we followed the nonparametric approach.

Among the productivity change indices, the Fisher (1922), Törnqvist (1936), and Malmquist (1953) indices are the most frequently used. Under certain conditions, the Malmquist index can be related to the Törnqvist and Fisher indices. Caves et al. (1982) showed that the Malmquist index is equivalent to the Törnqvist index if technology is translog, firms are cost minimizers, and profit maximizers, and second order terms are constant. Furthermore, Balk (1993) generalized the conditions explained by Färe and Grosskopf (1990) for calculating the Malmquist index as a quotient of the Fisher ideal index, and showed that if there is no allocative efficiency, these two indices are approximately equal.

We choose to use the Malmquist index for our productivity change analysis because it has a number of desirable properties, which makes it preferable over the Fisher and Törnqvist indices.

The Malmquist index was originally constructed by Sten Malmquist (1953) as a quantity index for consumption analysis. In their 1982 paper, Caves et al. adapted this consumption index to production analysis. In 1989, Färe et al. show the computation of this Malmquist productivity index using non-parametric linear programming methods.

The Malmquist index has many useful properties. As stated in Grifell-Tatjé and Lovell (1996), it does not require cost minimization or profit maximization and does not require any price information of inputs and outputs. At the same time, it can be used for multiple input and multiple output cases without aggregation problems.

Moreover, since the Malmquist index is constructed by means of a frontier model, it has the advantage of allowing for inefficient performance. The non-frontier productivity change measures, such as the index number approaches (like the Divisia and Törnqvist indices) or standard growth accounting approach (e.g. Solow (1957); Denison (1972)), assume that all individuals are efficient. So, in the existence of inefficiency, the estimation of technical progress would be biased. Furthermore, even in the absence of technical inefficiency, the TFP growth accounting estimation would be biased if the individuals are not cost minimizers; that is, if there is allocative inefficiency.

As an example, Färe et al. (1994a) showed the relationship between the Malmquist index and traditional measures of productivity growth by a Cobb-

Douglas production function. They stated that in the presence of inefficiency the Cobb-Douglas approach gives a biased estimate of technical change.

Maybe the most desirable feature of the Malmquist index is its decomposability. The first study decomposing productivity change into technical change and efficiency change was by Nishimizu and Page (1982). In this first decomposition however, a functional form specification for technology was required. In their 1989 paper, Färe et al. showed the decomposition of the Malmquist index into efficiency change and technical change by using non-parametric methods. By means of this new decomposition method, it became possible to see, without a necessity to estimate the technology parameters, whether productivity has improved through technological improvements (technical change) or through a more efficient use of the current technology (efficiency change).

To compute the Malmquist index, we need to calculate distance functions, which are functional representations of multiple input/multiple output technology. To calculate distance functions, we use the same technique as Färe et al. (1994a), namely DEA methodology. DEA is a linear programming methodology to construct a nonlinear piece-wise frontier over the data. The method received attention after Charnes et al. (1978) employed it and in where the term DEA was first used.

As stated in Coelli et al. (2005), "An introduction to efficiency and productivity analysis," one can also calculate distance functions using stochastic frontier approaches (SFA), which have the advantage of dealing with measurement error, but on the other hand, require imposing a particular

functional form for the production function and specifying distributional assumptions to separate the distance to the frontier function from measurement error.

3.2. TFP Literature

In the productivity literature there are many methods to measure TFP. For example, Mello (1999), "Foreign direct investment-led growth: evidence from time series and panel data" estimates the impact of foreign direct investment (FDI) on TFP growth for a sample of 32 OECD and non-OECD countries over the period 1970-90, where TFP growth is measured as the difference between per capita output growth and per capita capital accumulation. Results show a positive relationship between FDI and TFP for OECD countries, but a negative relationship for non-OECD countries.

"The creation and spread of technology and total factor productivity in China's agriculture" by Jin et al.(2001), uses the Divisia index for TFP measurement for the period 1982-1995. The results indicate that China's TFP for rice, wheat and maize grew rapidly and new technology accounts for most of the productivity growth. Moreover, in the paper "Subsidy and productivity in the privatised British passenger railway", (Cowie, 2002) productivity is examined through the use of a Törnqvist productivity index.

Lederman et al. (1999), in their paper "Economic reforms and total factor productivity growth in Latin America and Caribbean, 1950-95: An empirical

note," used the growth accounting approach based on the assumption that the production function follows a Cobb-Douglas form.

Using a stochastic frontier production function, Coelli et al. (2003) examined productivity growth in Bangladesh crop agriculture for the period 1961-1992, using data from 16 regions. Results show a productivity decline on the average during the period of study. Another paper using SFA, "A decomposition of TFP growth in Korean manufacturing industries: A stochastic frontier approach" by Kim and Han (2001), applied the stochastic frontier production model to Korean manufacturing industries. The paper decomposed total factor productivity into efficiency change, technical change, allocative efficiency change and scale efficiency change for the years 1980-1994, and showed that the main reason for productivity growth was technical progress.

3.3. Applications of the Malmquist Index

As we stated previously, the Malmquist index has very important advantages compared to other productivity measures. Thus, it has many applications to sectoral level productivity analyses.

Perhaps the most common use of the Malmquist index is in the banking sector. For example, "The sources of productivity change in Spanish banking", (Grifell-Tatje, Lovell, 1997), "Efficiency and Productivity Growth in Turkish Commercial Banking Sector: A non-parametric approach", (Fethi et al., 1998), "Measuring Productivity Changes in Australian Banking: An Application of Malmquist Indices" (Sathye, 2002), are some papers using the DEA-based Malmquist index in the banking sector.

Moreover, in their 1996 paper "Deregulation and productivity decline: The case of Spanish savings banks," Grifell-Tatje and Lovell examined TFP change in Spanish savings banks for the period 1986-1991 using the Malmquist index and found that liberalization of Spanish savings banks led to productivity declines. They explained their reason for choosing the Malmquist index as the productivity measure instead of the Törnqvist index, by citing the three main advantages of the Malmquist index. Specifically, the Malmquist index does not require price information on resources used and services provided, it decomposes productivity change into technical change and efficiency change and it does not require the assumption of profit maximization. The latter is an especially important feature of the Malmquist index for the authors, because the savings banks are not profit maximizers; consequently, it would be inappropriate to use an intertemporal profit function or Törnqvist productivity index, which requires cost minimization and revenue maximization, as a productivity measure.

Agriculture is another sector using the Malmquist index for productivity analysis. Coelli and Rao (2003) investigate productivity growth in the agriculture sectors of 93 developed and developing countries for 1980-2000 using the DEA-based Malmquist index. Results show positive productivity growth on the average, mostly due to technical change. Moreover, Nkamleu (2003), "Productivity growth, technical progress and efficiency change in African Agriculture" and Fulginiti and Perrin (1997), "LDC agriculture: nonparametric Malmquist productivity indexes" are two other cross-country studies on productivity in the agriculture sector.

The 1992 paper of Färe et al., "Productivity changes in Swedish pharmacies, 1980-1989: A nonparametric Malmquist approach," applied a DEA-based Malmquist index methodology to a panel data of Swedish pharmacies. By imposing a separability assumption on the distance functions, the authors decompose the Malmquist index into three components, namely, quality change, technical change and efficiency change. Results show that the data are not consistent with separability, since productivity growth changes according to the imposition of the separability assumption.

The Malmquist productivity index has a very wide range of sectoral applications for productivity analyses. We can name "Productivity development of Norwegian electricity distribution utilities" (Førsund and Kittelsen, 1997), "Productivity developments in Swedish hospitals: A Malmquist output index approach" (Färe et al., 1994b), "A comparative performance of the public enterprise sector in Turkey: A Malmquist productivity index approach" (Taskin, Zaim, 1997), "Productivity growth in health-care delivery" (Färe et al., 1997), "Productivity and quality changes in Swedish pharmacies" (Färe et al, 1994), "DEA-Malmquist productivity measure: New insights with an application to computer industry" (Chen and Ali, 2003), among others.

The Malmquist productivity index is used not only at the sectoral level, but also in aggregate level productivity analyses. For example, "The global trends of total factor productivity: Evidence from nonparametric Malmquist index approach" by Kruger (2003), investigated the productivity change in 87 countries for the period 1960-1990. The author states that the DEA-Malmquist approach has substantial advantages compared to traditional growth accounting,

since it does not rely on questionable equilibrium assumptions to merge multiple inputs into a single index and it can decompose the productivity change into technical change and efficiency change. Results show that technological progress occurs only in OECD countries and therefore in the range of relatively high capital intensity.

Moreover, "Total factor productivity measurement and human capital in OECD countries" Pastor et al. (1999), used the Malmquist index, including human capital, to calculate productivity in OECD countries for the period 1975-1990. Results indicated the existence of a significant effect on TFP associated with human capital.

3.4. Literature on Automotive Sector Productivity

Productivity analysis of the automotive sector usually uses labor productivity as a productivity measure. However, as we stated earlier, partial productivity measures may give misleading results, so TFP analyses are necessary. Moreover, perhaps due to the difficulty of finding cross-country comparable sectoral level data, analyses usually focus on specific regions and subsectors. Consequently, there is no research investigating global productivity trends of in the automotive industry.

The research on productivity in the automotive sector includes "Inventory Reduction and Productivity Growth; Linkages in the Japanese Automotive Industry", a paper by Lieberman and Demeester (1999). The paper used data for fifty-two Japanese automotive companies for the period 1965-1991 to evaluate

the inventory reduction and productivity relationship. In that paper, productivity is measured by labor productivity, which is defined as real value added per employee. It is found that firms increased their productivity rank during periods of substantial inventory reduction.

"Inventory reduction and productivity growth: A comparison of Japanese and US automotive sectors" by Lieberman and Asaba (1996), examines the inventory and productivity performances of the Japanese and US automotive sectors for the period 1967-1993. As a productivity growth measure, the authors used labor productivity and find a strong relationship between inventory reduction and productivity growth for the automotive sectors of both countries.

The productivity analyses on the sector usually focus on specific subsectors of the automotive industry, such as automobiles. For example, the 1990 paper of Lieberman, Lau and Williams: "Firm level productivity and Management Influence: A comparison of US and Japanese Automobile Producers" compares six major US and Japanese motor vehicle manufacturers for the period 1950-1987. To calculate productivity, labor, capital, and total factor productivity are used, where TFP growth is a weighted average of the growth rates of labor and capital productivity. It is found that improvements in productivity were the result of more efficient use of labor and for most of the firms, long-run growth in capital productivity was negligible.

Another research effort on automobiles is "International Relations and Productivity in the US Automobile Industry" (Kochan et al.(1987). In this paper, the authors investigated labor productivity for one American automobile

manufacturer's 53 plants for the period 1979-1986. Their results indicated negative effects of work teams on plant productivity.

Two 2002 papers by Ito "Are foreign multinationals more efficient? Plant productivity in the Thai automobile industry" and "Foreign ownership and productivity in the Indonesian automobile industry: Evidence from establishment data for 1990-1999" investigate the productivity differences between the foreign and local plants in the Thai and Indonesian automobile industries, respectively. For productivity calculations both labor productivity and total factor productivity, which is measured by the Törnqvist index, are used. In both papers, both labor productivity and TFP results reveal no evidence that foreign plants have relatively high productivity that can be related to their ownership-specific advantages.

Another paper by Ito (2004) "Foreign ownership and plant productivity in the Thai automobile industry in 1996 and 1998: A conditional quantile analysis" also investigates productivity differences between foreign and local plants in Thailand using labor productivity and a Törnqvist-Thail translog index of TFP; it confirmed the results of his 2002 paper.

Some research concentrates on automotive components industry. For example, "Foreign direct investment and host country productivity: the American automotive component industry in the 1980s" by Chung et al. (2003) examined the productivity of the US auto-component industry for the years 1979-1991 by estimating a log-linear Cobb Douglas production function to calculate productivity. The paper finds no evidence of direct technology transfer affecting the productivity of US suppliers.

"Product variety and manufacturing performance: Evidence from the international automotive assembly plant study" by MacDuffie et al. (1996), presents the cross-sectional examination of assembly plant productivity for the period 1985-1990, which is measured by labor productivity. Results indicated that an intermediate type of product variety negatively affects productivity.

CHAPTER IV

METHODOLOGY

To investigate productivity differences across countries, we use a non-parametric Malmquist productivity change index. In Chapter 3, by means of the productivity literature, we explained several advantages of this approach over other productivity change measures. In this chapter, we show the composition of this index and computation of it using linear programming techniques.

Formally, in order to define the output-oriented Malmquist index, we must first define the concept of output distance functions. An output distance function is the reciprocal of the maximal proportional expansion of the output vector, given input vector.[8] Hence, it is formulated as,

$$D_o^t(x^t, y^t) = \left(\sup\{\theta : \left(x^t, \theta y^t\right) \in S^t\}\right)^{-1} = \inf\{\theta : (x^t, y^t / \theta) \in S^t\}$$

where S^t is the production technology at time t, defined as

[8] An input distance function, on the other hand, describes the production technology by looking at the minimally possible proportional contraction of the input vector, given the output vector. The two measures provide the same technical efficiency scores when a constant returns to scale (CRS) technology applies, which is the case in this paper. For a further discussion of the input-oriented distance function, see Deaton (1979).

$S^t = \{(x^t, y^t) : x^t \text{ can produce } y^t\}, \quad t=1,2,\ldots,T,$

and x^t and y^t are the input and output vectors at time t, respectively.

Following Färe et al. (1994) we can write the Malmquist index as,

$$M_o(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \right) \left(\frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)} \right) \right]^{1/2}$$

where $D_o^t(x^{t+1}, y^{t+1}) = \inf\{\theta : (x^{t+1}, y^{t+1}/\theta) \in S^t\}$ and

$D_o^{t+1}(x^t, y^t) = \inf\{\theta : (x^t, y^t/\theta) \in S^{t+1}\}$.

Note that, the distance function $D_o^t(x^{t+1}, y^{t+1})$ describes the maximal proportional change in output, required to make (x^{t+1}, y^{t+1}) feasible in relation to the technology at t.

The Malmquist index methodology allows us to decompose productivity change into its efficiency change and technical change components. So, after some basic manipulations we get,

$$M_o(x^{t+1}, y^{t+1}, x^t, y^t) = \underbrace{\left(\frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \right)}_{\text{Efficiency Change}} \underbrace{\left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \right) \left(\frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)} \right) \right]^{1/2}}_{\text{Technical Change}}$$

In the present methodology, a world frontier is constructed using the data of the countries in the sample, and then each country is compared to that world frontier. In the formulation of the Malmquist index above, the first term measures whether the observed production of a country is getting closer to the world frontier between periods t and t+1, i.e., efficiency change. The second

term captures the technical change, i.e. shifts in the world frontier, so an improvement in this index is evidence of "innovation".

To be more informative, we can explain the framework for constant returns to scale technology with Figure 1 below.[9]

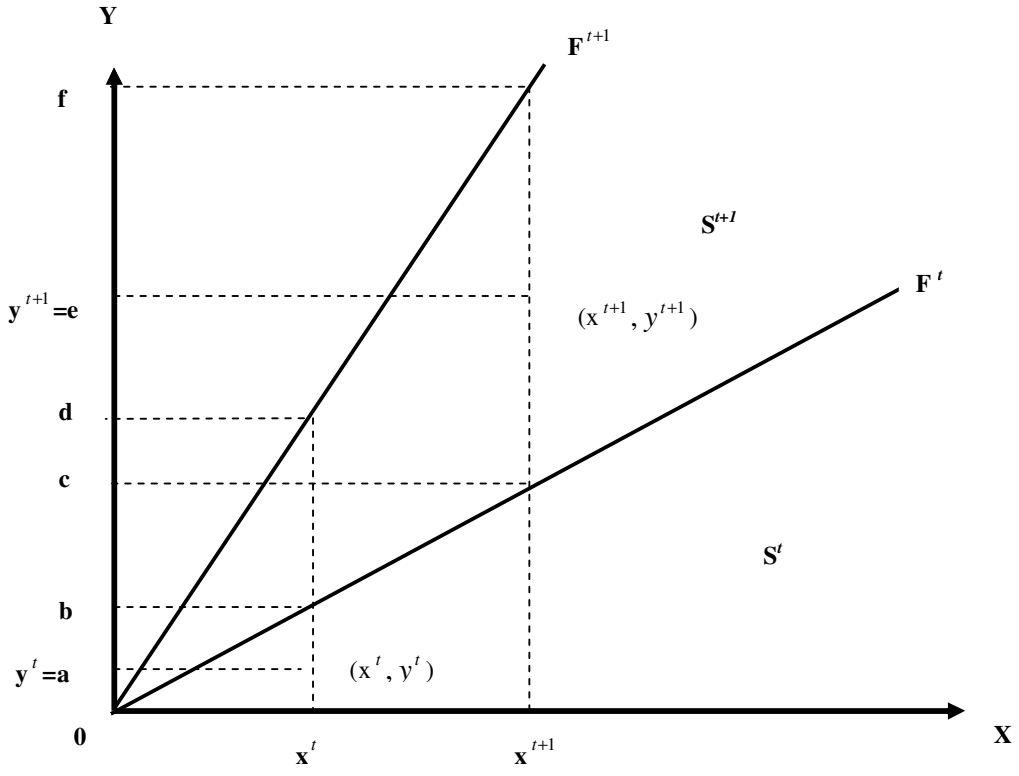

Figure 1: The Malmquist Productivity Change Index

In the figure, F^t and F^{t+1} are world frontiers for the periods t and t+1, respectively. Now, for any given country represented by (x^t,y^t) in period t, the output bundle y^t is inefficient because the country can produce b instead of y^t, without changing input bundle x^t and the technology level. The distance

[9] Source of the figure and the concept explained in this chapter is Färe et al., (1994).

function $D_o^t(x^t, y^t)$ is the reciprocal of the maximal ray expansion (or contraction) of y^t given x^t, so the value of this function is $\frac{oa}{ob}$, which is less than 1. Note that $D_o^t(x^t, y^t) \leq 1$ if and only if, $(x^t, y^t) \in S^t$, and $D_o^t(x^t, y^t) = 1$ if and only if (x^t, y^t) is on the frontier, that is, if technical efficiency exists. Furthermore, in the figure $(x^t, y^t) \in S^t$ and $(x^{t+1}, y^{t+1}) \in S^{t+1}$, but $(x^{t+1}, y^{t+1}) \notin S^t$, so we conclude that technical progress has occurred. Moreover, $D_o^t(x^{t+1}, y^{t+1})$, the distance function evaluating (x^{t+1}, y^{t+1}) relative to the period t technology level, is $\frac{oe}{oc}$, which is greater than 1.

Therefore, if we write the Malmquist index in terms of distances in the figure, it becomes,

$$M = \left[\frac{oe}{of} \Big/ \frac{oa}{ob}\right]\left[\left(\frac{oe}{oc} \Big/ \frac{oe}{of}\right)\left(\frac{oa}{ob} \Big/ \frac{oa}{od}\right)\right]^{1/2}.$$

Malmquist index values greater than unity indicate positive productivity growth between the two periods, t and t+1, and values less than unity suggest the converse. Similarly, improvements in the components of the Malmquist index yield values greater 1 of those components, and deteriorations yield values less than 1.

By comparing the values of technical efficiency change and technological change, we can understand the sources of productivity gains or losses. For instance, if the technical efficiency component is greater than the technological change component, then we can conclude that productivity gains are the result of efficiency improvements.

The calculation of the Malmquist index requires the solution of a sequence of linear programming problems. Assuming there are k=1,2,…,K observations (in our case, countries), N inputs and M outputs, and imposing constant returns to scale and strong disposability of technology, the following linear programs are computed to calculate the productivity of observation k^o:

$$\left[D_o^t(x^{k^O,t}, y^{k^O,t})\right]^{-1} = \max\theta$$

subject to

$$\theta y_{k^O,m}^t - \sum_{k=1}^K \lambda_k y_{k,m}^t \le 0 \quad , \quad \text{m} = 1,2,\ldots,\text{M}$$

$$\sum_{k=1}^K \lambda_k x_{k,n}^t - x_{k^O,n}^t \le 0 \quad , \quad \text{n} = 1,2,\ldots,\text{N} \qquad \textbf{(1)}$$

$$\lambda_k \ge 0 \quad , \quad \text{k} = 1,2,\ldots,\text{K}$$

$$\left[D_o^{t+1}(x^{k^O,t+1}, y^{k^O,t+1})\right]^{-1} = \max\theta$$

subject to

$$\theta y_{k^O,m}^{t+1} - \sum_{k=1}^K \lambda_k y_{k,m}^{t+1} \le 0 \quad , \quad \text{m} = 1,2,\ldots,\text{M}$$

$$\sum_{k=1}^K \lambda_k x_{k,n}^{t+1} - x_{k^O,n}^{t+1} \le 0 \quad , \quad \text{n} = 1,2,\ldots,\text{N} \qquad \textbf{(2)}$$

$$\lambda_k \ge 0 \quad , \quad \text{k} = 1,2,\ldots,\text{K}$$

$$\left[D_o^t(x^{k^O,t+1}, y^{k^O,t+1})\right]^{-1} = \max\theta$$

subject to

$$\theta y_{k^O,m}^{t+1} - \sum_{k=1}^{K} \lambda_k y_{k,m}^t \leq 0 \quad , \quad \text{m} = 1,2,\ldots,\text{M}$$

$$\sum_{k=1}^{K} \lambda_k x_{k,n}^t - x_{k^O,n}^{t+1} \leq 0 \quad , \quad \text{n} = 1,2,\ldots,\text{N} \qquad \textbf{(3)}$$

$$\lambda_k \geq 0 \quad , \quad \text{k} = 1,2,\ldots,\text{K}$$

$$\left[D_o^{t+1}(x^{k^O,t}, y^{k^O,t})\right]^{-1} = \max\theta$$

subject to

$$\theta y_{k^O,m}^{t} - \sum_{k=1}^{K} \lambda_k y_{k,m}^{t+1} \leq 0 \quad , \quad \text{m} = 1,2,\ldots,\text{M}$$

$$\sum_{k=1}^{K} \lambda_k x_{k,n}^{t+1} - x_{k^O,n}^{t} \leq 0 \quad , \quad \text{n} = 1,2,\ldots,\text{N} \qquad \textbf{(4)}$$

$$\lambda_k \geq 0 \quad , \quad \text{k} = 1,2,\ldots,\text{K}$$

where t = 1,2,…,T, and λ_k indicates at what intensity a country may be employed in production. In programs (1) and (2) the observation and the technology are from the same period, so the value of the Malmquist index is less than or equal to unity. Where linear programs (3) and (4) occur, the observation is from one period, but the reference technology is from another period.

Note that, to this point, we have assumed a constant returns to scale technology. By adding the convexity constraint $\sum_{k=1}^{K} \lambda_k = 1$ in all of the linear programming programs above, we can obtain efficiency scores relative to a variable returns to scale technology, and thus can decompose the overall efficiency change (the change in efficiency calculated relative to the constant

returns to scale technology) into scale efficiency change and pure efficiency change components.

The pure efficiency component is the technical efficiency calculated under VRS technology, and scale efficiency is the component that captures the deviation between VRS technology and CRS technology at the observed inputs. An increase in scale efficiency means that the country has moved to a position with a better input/output quantity ratio at the frontier, conditioned on its input/output mix.

By running programs (1) and (2) with and without convexity constraints, we can measure pure technical efficiency change (PEFFCH) and overall technical efficiency change (EFFCH), respectively. Scale efficiency change (SEFFCH) can be obtained by dividing overall technical efficiency change by pure technical efficiency change. Therefore, we can write that;

EFFCH = PEFFCH * SEFFCH.

Then, using the same logic as above, if the pure technical efficiency index is greater than the scale efficiency index, we can say that the source of the efficiency change is an improvement in pure technical efficiency.

Now we apply this procedure to the data of 26 selected countries. But first let us mention the data.

CHAPTER V

DATA

To compute the Malmquist productivity change index, we need output, labor and capital stock data at the sectoral level, comparable across countries and over time. Our data source is United Nation's Industrial Statistics database (INDSTAT3 2006 ISIC rev.2), and data are defined at the three-digit level of the International Standard Industrial Classification (ISIC) code. Although this data source covers the period 1963-2004 for a set of 181 countries, for the majority of the countries, data are not available for a large proportion of this time span. Hence, we choose countries in our sample according to availability of sector level data in the data set. To get the most reliable results, we restricted our data set to 26 countries over the time period from 1964 to 2002.[10]

The set of countries is reported in Table 6 with their value added/labor indices in the automotive sector for years 1981, 1990, and 2000. This index is calculated using the formula:

[10] Moreover, for the data of 10 countries we made estimations to complete the missing data for labor, output, and invesment. To complete output and labor data, we fitted the linear functions Y=a+bT and L=c+dT, respectively, where T is the time trend. To complete investment data, first we found the average of available i ratios for each country, where i=I/Y, and then we used this ratio to calculate unavailable I levels using I=i*Y.

I_i = (Value $Added_i$/$Labor_i$)/ (Value $Added_{Turkey}$/$Labor_{Turkey}$)*100, where i represents the country and for Turkey it takes the value 100. So the index indicates the performance of the automotive sectors of countries relative to that of Turkey.

Table 6: Relative Value Added/Labor Indices in Automotive Sectors

COUNTRY	VA/L Index 1981	VA/L index 1990	VA/L index 2000
AUSTRIA	627.218	703.489	625.249
CANADA	2033.609	1678.374	2332.769
DENMARK	883.834	722.284	556.780
FINLAND	1261.429	927.880	311.905
FRANCE	2134.887	1660.237	948.549
GERMANY	2791.053	2794.371	2224.600
GREECE	365.112	158.183	123.485
ITALY	1217.444	844.371	451.543
JAPAN	2395.414	2547.038	1952.448
NETHERLANDS	712.932	542.462	397.841
NORWAY	1689.549	797.597	1021.281
PORTUGAL	239.022	192.165	262.473
SPAIN	727.819	874.292	539.939
SWEDEN	3001.955	2484.036	1508.540
UK	2108.797	1655.267	910.628
USA	2861.353	1979.724	1779.206
Industrial mean	1565.714	744.809	996.702
CHILE	130.075	38.117	52.517
COLOMBIA	74.360	31.369	14.365
ECUADOR	26.616	6.978	4.084
HUNGARY	361.954	125.773	258.110
INDIA	13.909	9.084	5.778
KOREA	690.300	1673.700	2562.451
POLAND	416.466	160.204	119.586
TURKEY	100	100	100
VENEZUELA	370	33.015	83.870
ZIMBABWE	52.180	25.246	18.867
Developing mean	223.586	204.278	321.962

According to the table,[11] Turkey is one of the worst performing countries in terms of value added per labor in the automotive sector. In 1981, out of 26 countries in the data set, only four countries had smaller index values than Turkey, which are Colombia, Ecuador, India, and Zimbabwe, all of which are developing countries. Value added per labor values for Japan, USA, Canada, the UK, Germany, France, and Sweden are more than 20 times that of Turkey's value. This means that value added gains from automotive sector labor in these countries are 20 times more than gains from automotive labor in Turkey. On the average, the labor efficiency of industrial countries is sevenfold of that of developing countries. Countries like Korea, Hungary, Poland, and Venezuela, with which Turkey is expected to compete, also had greater values than Turkey's. In 1990 and 2000, Turkey showed a better performance and lessened its differential versus other countries: in addition to the formerly mentioned four countries, Turkey's labor efficiency performance exceeded those of Chile and Venezuela. Korea showed a great improvement and achieved the top rank in value added per labor value in the automotive sector in 2000.

For the automotive sector, we would like to have data on motor vehicles, parts, and accessories production. At a three-digit industry classification, this sector is grouped under code 384, which is the "Transport Equipment" sector. The definition of transport equipment covers shipbuilding and repairing, manufacture of railroad equipment, motor vehicles, motorcycles and bicycles,

[11] Source of labor and value added data is INDSTAT3 2006, ISIC rev.2. Definitions of data are given in the Appendix B.

aircraft and manufacture of transport equipment not elsewhere classified. The breakdown of this sector's data is not available for the entire period 1964-2002.

However, for years when industry data are available at a four-digit level classification, it is possible to compute the share of the automotive sector defined as "motor vehicles, parts, and accessories production" within this general definition of the transport equipment sector. We found that approximately 75% of the transport equipment sector is composed of automotive-related production. Hence, the data for the sector 384 is usable, at a three-digit classification, to approximate automotive sector production information. Data used here cover all sectoral activities occurred in a reporting country, including activities of foreign affiliates.

To calculate productivity, we use value added data[12] as output data and for labor input, we use the number of employees[13]. Capital levels for the sector are not available in the data set. Values of capital inputs for the automotive sector can be found on an individual country basis. However, this is possible for a very limited number of countries. Most of the time, data are not available for any length of time and most importantly, values are not comparable across countries. Units of measurement or coverage differs from one country to another.

Hence, in this study, following King, Levine (1994), capital stock series for each country is computed using the standard perpetual inventory method of

[12] The definitions of value added and gross fixed capital formation are given in Appendix B.

[13] Definition of the Number of Employees data is given in Appendix B.

estimating capital stock. In this method, capital stock for each year is computed as the sum of depreciated capital stock and investment levels of the previous year, that is:

$K_t = I_{t-1} + (1-\delta)K_{t-1}$, t=1964,...,2002

where the depreciation rate of capital, δ, is taken to be 7%[14] based on the studies of Good, et al. (2005), and Easterly and Levine (2002), among others. In our calculations of capital stock series, the investment level, I, is proxied for each year and for each country in the sector by gross fixed capital formation.[15] In this method, when we compute the capital stock levels of the countries for the sector, we made the assumption that the initial year capital stock levels, K_{1964}, for all countries in the sample are zero. To decrease the effect of this approximation on our productivity results, we start our productivity measurements from 1972. If there are significant differences in initial capital stock values across countries, with a 7% depreciation rate, omitting 1964-1971 period will alleviate the impact of this approximation on our productivity results.

[14] Robustness of our results relative to the choice of depreciation rate is checked.

[15] As stated in footnote 2, to complete the investment, namely gross fixed capital formation data, first we found the average of available i ratios for each country, where i=I/Y, and then we used this ratio to calculate unavailable I levels using I=i*Y. Definition of the Gross Fixed Capital Formation data is given in Appendix B.

CHAPTER VI

EMPIRICAL RESULTS

6.1. Malmquist Index and Components

In this section, we calculate productivity changes in the automotive sector for a sample of 26 industrial and developing countries for the period 1972-2002. The changes in productivity are computed using the concept of the Malmquist productivity change index defined in Chapter 4. For calculations of the Malmquist indices, we need to solve four different linear programming programs for each pairs of years, for each country. For 26 countries and 30 years in the data set, we calculated 3120 linear programming problems utilizing the Data Envelopment Analysis (Computer) Program (DEAP) Version 2.1.

We calculate the Malmquist productivity change index values for every year and every country in the sample. The results are presented in Table 1 of Appendix C. Recall that, a value of Malmquist index or any of its components is less than 1 indicates deterioration in performance while values greater than 1 are indicators of improvements in performance. Hence, if we look at the first column of Table 1 in Appendix C, in 1973, Austria had a Malmquist index value of 1.149, which shows a 14.9% productivity gain relative to the previous

year. Denmark, on the other hand, experienced a productivity decline with an index value of 0.963. This shows a negative change of 3.7% in its automotive sector productivity.

We compute the mean values of the Malmquist productivity change index and its components for the automotive sector in each country in the sample for the entire period and for three sub-periods. Table 7 shows the summary results by separating the industrial and developing country groups. Note that Malmquist index mean values are calculated as geometric means since the index itself is a geometric mean of two Malmquist indices. Also, since the Malmquist index measures the change in productivity relative to the previous year, productivity results start with the year 1973.

Table 7: Malmquist Index and Components, Summary of Means

	1973-2002	**1973-1982**	**1983-1992**	**1993-2002**
Industrial countries				
Malmquist index	1.013	1.014	1.024	1.002
Efficiency change	1.003	1.021	1.004	0.990
Technical change	1.010	0.995	1.019	1.013
Developing countries				
Malmquist index	0.990	0.977	0.975	1.020
Efficiency change	1.002	1.022	0.964	1.021
Technical change	0.988	0.955	1.011	0.999
All Countries				
Malmquist index	1.004	1.000	1.005	1.009
Efficiency change	1.002	1.021	0.990	1.001
Technical change	1.002	0.980	1.016	1.008

As seen in the table, considering all countries in the sample, for the period 1973-2002, there has been a productivity gain of 0.4% on the average.

This productivity improvement is composed of a 0.2% efficiency change and a 0.2% technical change. Over the three periods, an increasing trend is evident in the period averages of mean productivity change for the entire set of countries. In the first period, the productivity average for all countries shows a value of 1.000, which means that, on the average, countries experienced neither a gain nor a loss in productivity. In the second and third periods, productivity change values show positive increases of 0.5% and 0.9%, respectively.

Considering country groups for the entire period of study, industrial countries had a productivity improvement of 1.3% in the automotive sector while developing countries experienced a decline of 1%. In the first and second periods, industrial countries showed an increasing trend, but in the final period, productivity change, although still positive, slowed down compared to previous periods. The opposite is true for the developing country group; in the first and second periods, this group of countries showed declines of 2.3% and 2.5%, respectively, but in the last period, productivity change showed an important improvement and they experienced 2% productivity gain. Even though these geometrics means show differences in overall performance of the country groups, the statistical tests of equality group means are performed below .

The Malmquist productivity change index is composed of efficiency and technical change indices. The efficiency change index is a measure of whether the production of a country is progressing toward the world frontier, which we call “catching-up”. Technical change, on the other hand, measures how much the world technology frontier shifts with each country’s input mix; that is, “innovation.” For industrial countries, the decomposition of the productivity

index shows that technical change has a more significant role in productivity improvement than efficiency change. Although during the first period from 1973 to 1982, the technical change for industrial countries showed deterioration, in the second and third periods, namely 1983-1992 and 1993-2002, it improved; in the last period, it became the main reason for the positive change in Malmquist productivity. So the productivity gains of industrial countries primarily resulted from the utilization of new technologies in the sector. In the case of the developing countries in our sample, efficiency change seems to be the factor that leads to improvements in productivity. The technical change index of developing countries showed a decline of 1.2%, while efficiency change was positive at 0.2%. Hence, the mean scores for the complete period indicate that the gains resulted from catching-up to the world frontier rather than innovations in production technology. The first column of Table 7 shows that, on the average, industrial countries are better performers in terms of both efficiency improvements and technical change scores.

To determine which countries are the best performers in terms of productivity changes, we need the country-by-country results. Table 8 presents the country-by-country mean Malmquist index results; the results are sorted according to the mean Malmquist index from highest to lowest for each group of countries.

Table 8: Malmquist Productivity Change Index

Industrial countries	**1973-2002**	**1973-1982**	**1983-1992**	**1993-2002**
Japan	1.080	1.127	1.099	1.017
Germany	1.042	1.080	1.068	0.980
Austria	1.036	0.989	1.122	1.001
France	1.035	1.064	1.044	0.995
Greece	1.027	1.007	1.046	1.028
Sweden	1.026	1.074	0.971	1.034
USA	1.021	1.018	1.024	1.019
Netherlands	1.012	0.964	0.997	1.076
Canada	1.009	0.982	1.015	1.030
Finland	1.009	1.047	0.980	1.001
Italy	1.006	1.051	0.984	0.983
Norway	0.995	0.958	1.006	1.020
Denmark	0.989	0.973	0.992	1.001
Portugal	0.978	0.933	1.039	0.962
Spain	0.978	0.998	1.010	0.926
UK	0.978	0.967	1.000	0.966
Industrial mean	**1.013**	**1.014**	**1.024**	**1.002**
Developingcountries	**1973-2002**	**1973-1982**	**1983-1992**	**1993-2002**
Korea	1.028	0.997	1.054	1.032
Colombia	1.017	0.988	0.972	1.093
Chile	1.013	0.954	1.116	0.976
Venezuela	1.002	1.066	0.960	0.982
India	0.999	1.007	0.978	1.010
Turkey	0.979	0.962	1.042	0.935
Hungary	0.975	0.938	0.914	1.082
Zimbabwe	0.971	0.962	0.927	1.025
Poland	0.962	0.957	0.890	1.042
Ecuador	0.956	0.943	0.903	1.025
Developing mean	**0.990**	**0.977**	**0.975**	**1.020**
TOTAL MEAN	**1.004**	**1.000**	**1.005**	**1.009**

Table 8 shows most industrial countries exhibited productivity improvements over the sample period. Only five of the industrial countries, Denmark, Norway, Portugal, Spain and UK, were the exceptions; they experienced a productivity loss. The largest productivity gains were observed for Japan and Germany. Within the developing country group, which as a group

showed deterioration of productivity, Korea, Chile, Colombia and Venezuela are ones that experienced productivity gains with a mean Malmquist index greater than one.

Examining countries individually, Japan is ranked first with a Malmquist productivity increase of 8% for the period 1973-2002. Korea is ranked first among developing countries with a productivity gain of 2.8%; with this value of productivity change, the country is ranked fifth in the sample. Turkey has experienced 2.1% deterioration in its productivity and is ranked the 18th within our sample of 26 countries.

To examine changes in individual country performances over the sample period, we divided the sample into three decades; the first period is 1973-1982, the second period is 1983-1992 and the third period is 1993-2002. The first period showed that the industrial country group improved its productivity by 1.4% and developing countries experienced a mean productivity loss of 2.3%. The industrial countries have productivity improvements but the majority of the developing countries experience a loss in productivity. Among developing countries, only India and Venezuela achieved positive changes in productivity for the first period. Japan was the best performer during this period. Turkey could not show a good performance and experienced 3.8% deterioration in productivity and ranked the 20th among all countries.

In the second period, which is the period that resulted in the best productivity performance for industrial countries and the worst performance for automotive producers in developing countries, the first group had a 2.4% productivity improvement and the latter showed a productivity deterioration of

2.5%. During this period, Austria attained the top rank in the sample. Among developing countries Chile showed an 11.6% improvement and achieved the top rank. Turkey's automotive sector productivity increased by 4.2%; it is ranked eighth showing a large improvement relative to the previous decade.

In the final decade in our sample, both industrial and developing country groups experienced improvements in performance with 0.2% and 2% increases, respectively. This period is the only time in our sample where developing countries outperformed industrial countries in terms of productivity changes in the automotive sector. Most of the developing countries showed positive productivity changes, but Chile, Turkey, and Venezuela are the only countries that had productivity declines during this period. Turkey was one of the worst performers with a 6.5% regression in productivity and it is ranked the 25^{th} for this period. The crude examination of individual country performance shows that no country has a consistent performance over all three periods. The countries' performances show variation across the three decades included into our sample. The countries that had a positive mean productivity change for the three periods are USA and Greece.

Although Table 8 gives the productivity changes for the countries, it does not explain reasons behind these changes. By decomposing the Malmquist index into its technical change and efficiency change components, we can analyze the sources of productivity changes in the automotive sector. For this purpose, we report the efficiency change and technical change results in Table 9 and Table 10, respectively.

Table 9: Efficiency Change Index

Industrial Countries	1973-2002	1973-1982	1983-1992	1993-2002
Japan	1.022	1.038	1.031	0.995
Netherlands	1.017	1.041	0.995	1.044
Austria	1.010	1.074	1.068	0.972
Norway	1.010	1.006	1.005	1.018
Greece	1.009	1.021	0.994	1.011
France	1.006	1.025	1.026	0.968
Finland	1.005	1.046	0.973	0.995
Denmark	1.004	1.020	0.988	1.002
Germany	1.002	1.022	1.028	0.958
Sweden	1.000	1.020	0.955	1.025
USA	1.000	0.999	1.000	0.794
Canada	0.998	0.989	0.993	1.011
Portugal	0.997	0.983	1.040	0.967
Spain	0.993	1.048	1.002	0.932
Italy	0.991	1.054	0.973	0.949
UK	0.989	1.014	0.994	0.959
Industrialmean	**1.003**	**1.021**	**1.004**	**0.990**
Developing C.	**1973-2002**	**1973-1982**	**1983-1992**	**1993-2002**
Korea	1.032	1.044	1.042	1.010
Colombia	1.021	1.039	0.959	1.069
Chile	1.017	0.997	1.074	0.980
Venezuela	1.013	1.098	0.958	0.987
India	1.007	1.055	0.946	1.009
Hungary	0.995	0.987	0.912	0.869
Turkey	0.994	1.010	1.035	0.940
Zimbabwe	0.982	1.008	0.916	1.024
Poland	0.976	1.005	0.891	1.038
Ecuador	0.975	0.983	0.910	1.034
Developingmean	**1.002**	**1.022**	**0.964**	**1.021**
TOTAL MEAN	**1.002**	**1.021**	**0.990**	**1.001**

According to Table 9, productivity gain in industrial countries is affected by a 0.3% increase in catching-up performance. Considering sub-periods, in the first period, this group of countries showed 2.1% increase in efficiency. Here, the majority of industrial countries experienced improvement in efficiency. In the second period efficiency change, although still positive, fell back to 0.4%

and in the last period, performance in this group deteriorated 1%. In the last two decades of our sample, most of the industrialized countries were not moving closer to the best practice frontier from one year to the next.

In the case of developing countries, the average change in efficiency was an improvement of 0.2% for the entire sample. For the sub-periods, the first and last decades were better in terms of catching-up to the best practice frontier. Although there is a decline in the performance of this group in the second period, efficiency change rose to a positive value again in the third period. Even though there are no consistent patterns of performance in this group, Korea and India were the two countries which had positive productivity improvements for all three periods in the sample.[16]

The second component of productivity change is the technical change component. This indicates whether, for the specific input/output mix of the producer, the frontier has shifted outward and productivity has improved due to technical innovation. The summary results for the technical change index for the entire time and the sub-periods are reported in Table 10.

[16] Moreover, we divided the efficiency change index into two further indices, namely, pure efficiency change and scale efficiency change indices, and we present the results in Table 2 of Appendix C. Results show that for both groups of countries, productivity gains from efficiency change are resulted from the pure efficiency change component. An increase in the pure efficiency index means that the country has moved to a position with a better input/output quantity ratio at the frontier, conditional on its input/output mix. So we can say that for the both groups, the source of the efficiency change is input/output configuration rather than the size of operation.

Table 10: Technical Change Index

Industrial Countries	1973-2002	1973-1982	1983-1992	1993-2002
Japan	1.058	1.085	1.056	1.022
Germany	1.039	1.056	1.039	1.022
France	1.028	1.039	1.017	1.019
Austria	1.026	0.998	1.050	1.029
Sweden	1.026	1.052	1.016	1.008
USA	1.021	1.018	1.024	1.019
Greece	1.018	0.985	1.052	1.016
Italy	1.015	0.996	1.020	1.035
Canada	1.011	0.992	1.022	1.018
Finland	1.005	1.001	0.998	1.006
Netherlands	0.995	0.954	1.001	1.021
UK	0.988	0.953	1.006	1.006
Denmark	0.986	0.953	1.004	0.999
Norway	0.985	0.952	1.000	1.001
Spain	0.984	0.951	1.007	0.994
Portugal	0.981	0.949	0.998	0.995
Industrial mean	**1.010**	**0.995**	**1.019**	**1.013**
Developing Countries	**1973-2002**	**1973-1982**	**1983-1992**	**1993-2002**
Chile	0.997	0.957	1.039	0.995
Korea	0.996	0.955	1.012	1.021
Colombia	0.995	0.951	1.013	1.022
India	0.991	0.954	1.034	0.987
Venezuela	0.989	0.970	1.001	0.995
Zimbabwe	0.989	0.954	1.012	1.001
Poland	0.985	0.952	0.999	1.003
Turkey	0.984	0.952	1.006	0.994
Ecuador	0.981	0.959	0.993	0.992
Hungary	0.980	0.949	1.002	0.988
Developing mean	**0.988**	**0.955**	**1.011**	**0.999**
TOTAL MEAN	**1.002**	**0.980**	**1.016**	**1.008**

Table 10 shows that industrial countries exhibit an improvement in productivity due to technical change of 1% during the complete sample period. The developing countries, on the other hand, show deterioration in this component. Considering the individual country performances, most of the

industrial countries, which are also the leading automotive producers as determined in Chapter 2, experienced a shift outward toward the production frontier. This performance is more dramatic in the second and third decades of the sample. Japan, Germany, France, USA, and Sweden show positive results in the technical change index for all sub-periods, which means that these are the innovator countries in the automotive sector. This is not surprising, especially since Japan, Germany, and USA are known to be the technology leaders in the world. On the average, innovations in the sector come mainly from the industrial countries.

In fact, among developing countries, for the first sub-period, there is no country shifting the world frontier through innovations it has made, since all of the technical change values are less than 1. However, in the second and third sub-periods, there is improvement in this component of productivity for developing countries, on the average. In fact, if we consider the developing countries individually, comparing the last and first sub-period values, we see that all developing countries experienced improvements in technical change. This shows that, today developing countries are utilizing more new technologies and techniques in the automotive sector, and with their input/output mix in production, they are able to shift the production frontier to a certain extent. This is expected since, as mentioned previously, today, automotive firms have facilities all over the world and this makes technology transfer easier as compared to an earlier era. Moreover, by means of free trade agreements and globalization of production, especially in the automotive sector, technological

interaction among the countries has increased and technological differences have decreased.

As for the individual country experiences, Chile, Korea, Colombia, and India showed significant improvements in the technological change index, especially over the last two sub-periods. Hence, the productivity improvements in these countries cannot be attributed only to efficiency change, but also to technical change.

Even though there seems to be some variation in the performance of individual countries over different periods, it is important to determine statistically whether countries changed their relative performance over the sample period. Hence, we would like to determine whether performances of the countries are significantly different over the full time horizon. That is, finding whether a country that is good at shifting the frontier in the first period is also good at a frontier shift in the second and/or third periods, or ascertaining if a country that is a best performer in terms of catching-up, is always good. To determine these issues, we need to compare the sub-period rankings of the countries. If there is a significant correlation among sub-period rankings, we conclude that the best and the worst performer countries, with respect to Malmquist productivity change, efficiency change or technical change, do not change significantly through the periods.

We checked the correlations for the Malmquist index, efficiency change index and technical change index sub-period rankings of industrial and developing country groups utilizing a non-parametric rank statistic proposed by Spearman (1904).

Spearman's rank correlation coefficient is calculated as $\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$,

and t value is $t = \frac{\rho}{\sqrt{(1-\rho^2)/(n-2)}}$ where $d_i = x_i - y_i$ is the difference between the ranks of corresponding index values X_i and Y_i for the sub-periods; and n is the number of observations in each period for a specific country group. For each country group, we test the null hypothesis that the index ranks of two sub-periods are not correlated; that is, as the ranks of one period increase, the ranks of the other period are not more likely to increase or decrease.

Results show no significant correlation between the sub-period rankings for the Malmquist index and the sub-period rankings of the efficiency index. This is true for both the industrial countries and for the developing countries. Technical change rankings of industrial countries are found to be positively correlated at the 0.05 significance level for all periods. But the technical change rankings for developing countries are not found to be correlated. Moreover, considering all countries in the sample, we found correlations in the efficiency change, technical change and Malmquist productivity change sub-period rankings. For the technical change component especially, significant correlations were found in all sub-period rankings. Results are represented in Table 11 with the Spearman's correlation coefficients and corresponding p values. Full results are reported in Table 3 of Appendix C.

Table 11: Rank Correlation Results

All countries Malmquist technical change rank correlation.				
		1st period	2nd period	3rd period
1st period	correlation coefficient	1.000**	0.555**	0.562**
	p value	0.000	0.003	0.003
2nd period	correlation coefficient	0.555**	1.000**	0.486*
	p value	0.003	0.000	0.012
3rd period	correlation coefficient	0.562**	0.486*	1.000**
	p value	0.003	0.012	0.000
Industrial countries technical change rank correlation.				
1st period	correlation coefficient	1.000**	0.605*	0.684**
	p value	0.000	0.013	0.004
2nd period	correlation coefficient	0.605*	1.000**	0.670**
	p value	0.013	0.000	0.004
3rd period	correlation coefficient	0.684**	0.670**	1.000**
	p value	0.004	0.004	0.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

These correlations, between the technical change rankings of the industrial countries and technical change rankings of all countries, mean that the innovator countries of the sector are usually the same countries throughout all of the periods and do not change significantly. The countries that are innovators in the first period are the innovators in the second and the third periods. This is further evidence that even though overall sectoral overall performance of a country may depend on changing economic conditions, the capacity to innovate and technical change are determined by factors that do not change quickly over time. Depending on the economic environment, the firms may improve their productivity and efficiency performances. However, factors that determine technical change, such as human capital, education, and capacity to innovate, are present in certain countries that tend to be the innovators in the world and they are able to maintain this capacity even over a thirty-year period.

Productivity performance of the industrial and developing country groups in individual years is portrayed in Figures 2, 3, and 4. Figure 2 shows the evolution of percentage Malmquist productivity change during the study years for industrial and developing countries.

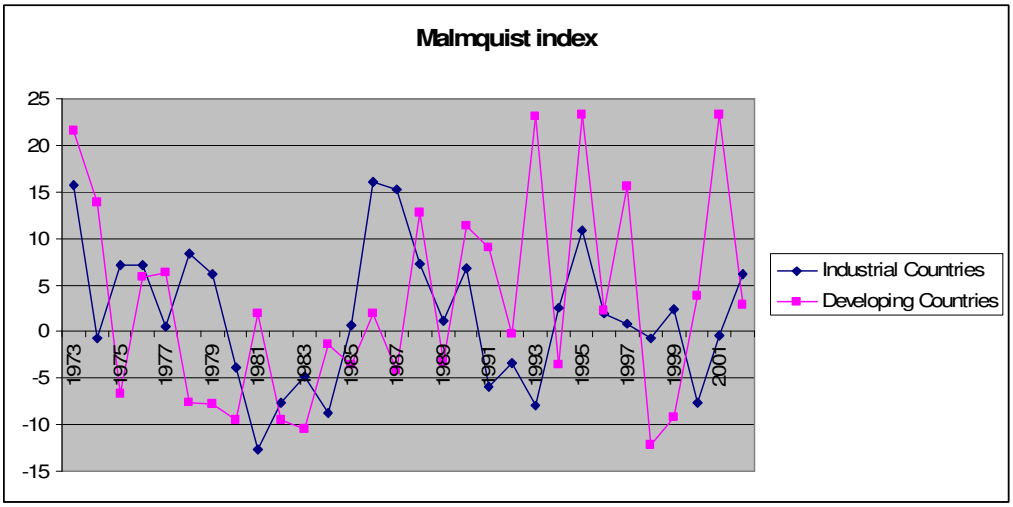

Figure 2: Malmquist Index Evolutions of Country Groups

If we look at the figure, in the first period, both groups show a decreasing trend in productivity. Note that this period coincides with the 1973 oil crisis. In 1973, the Organization of Petroleum Exporting Countries, OPEC, caused an increase in oil prices by cutting back on world supply. This decision precipitated an economic crisis at the worldwide level with high inflation, high unemployment, and decreasing demand for automotive products. Hence, the reason for this decreasing trend in productivity may be the oil crisis of 1973 since the effects of this crisis were felt well into the mid-1980s.

The period after 1985 shows quite a bit of variation in the industrial and developing countries' productivity changes. For the industrial countries, the

productivity changes follow a cyclical pattern. In most of the years of economic expansion, the productivity changes in these countries are positive and in years of economic downturn, such as in 1993 and 1999 -these are the years that the European Automobile Manufacturers' Association (ACEA) indicated were the years when the lowest number of car registrations occurred in Europe- productivity changes become negative.

The developing countries, after relatively poor performance, showed improvement in productivity changes. However, according to the graphs, there is much variation from one year to the next in the Malmquist productivity change index.

To arrive at a conclusion about the relative performance of these two groups of countries, we examined the equality of means and variances across the industrial and developing country groups. To test the equality of means, we utilized the t test.

The t test, assuming a normal distribution of data, tests whether the means of two groups are statistically different from each other. The calculation of the test statistic differs according to the assumption of equality of variances of the variables. If equal variances are assumed then we use the test statistic

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{X_1X_2} \cdot \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

where

$$S_{X_1X_2} = \sqrt{\frac{(n_1 - 1)S_{X1}^2 + (n_2 - 1)S_{X2}^2}{n_1 + n_2 - 2}}.$$

and n_1 and n_2 are the sample sizes for group 1 and 2, respectively.

If the variances are not equal, then, $t = \dfrac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}}$ where

$$S_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}.$$

Hence, before applying the t test, we need to test the equality of variances of the variables. For this, we utilized Levene's test of equality of variances. This test, without requiring normality of the underlying data, tests the null hypothesis that "the population variances are equal." If the p-value of Levene's test is less than the critical value, then the null hypothesis of equal variances is rejected and it is concluded that there is a difference between the variances of the populations.

The test calculates the result as

$$W = \frac{(N-k)}{(k-1)} \frac{\sum_{i=1}^{k} N_i (Z_{i\cdot} - Z_{\cdot\cdot})^2}{\sum_{i=1}^{k} \sum_{j=1}^{N_i} (Z_{ij} - Z_{i\cdot})^2},$$

where k is the number of groups, N_i is the number of observations in the i^{th} group, N is the total number of observations and Y_{ij} is the value of the j^{th} observation from the i^{th} group. Here,

$Z_{ij} = |Y_{ij} - \bar{Y}_{i\cdot}|$ with $\bar{Y}_{i\cdot}$ the median of group i,

$Z_{\cdot\cdot} = \dfrac{1}{N} \sum_{i=1}^{k} \sum_{j=1}^{N_i} Z_{ij}$ and

$$Z_{i\cdot} = \frac{1}{N_i}\sum_{j=1}^{N_i} Z_{ij}$$

The significance of W is tested against F (α,k – 1,N – k) where k – 1 and N – k are the degrees of freedom, and α is significance level.

Results of the equality of variances and the equality of means tests in Figure 2 indicate no significant difference between the means of the industrial and developing country groups' productivity changes over the entire period and for the sub-periods. The resulting p values for the means test of the Malmquist index and its components are reported in Table 12. The equality of variances results for the Malmquist productivity change index and its components for the two groups of countries, for the complete period and for the sub-samples are reported in Table 13. The results indicate that the variance of the malmquist productivity change index differ for the industrialized and developing economies. The malmquist productivity index variance for these two group of countries is different mainly due to differece in variances in the third period. \

Table 12: Equality of Means for Country Groups (p Values)

	Malmquist	**Eff.ch.**	**Tech. Ch.**
Whole period	0.609	0.622	0.382
1st period	0.792	0.720	0.480
2nd period	0.743	0.756	0.828
3rd period	0.505	0.509	0.983

Table 13: Equality of Variance for Country Groups (p Values)

	Malmquist	**Eff.ch.**	**Tech. Ch.**
Whole period	0.035	0.345	0.800
1st period	0.323	0.739	0.444
2nd period	0.567	0.898	0.541
3rd period	0.004	0.371	0.171

Figure 3 and Figure 4 show the efficiency change and technical change evolutions of the country groups, respectively.

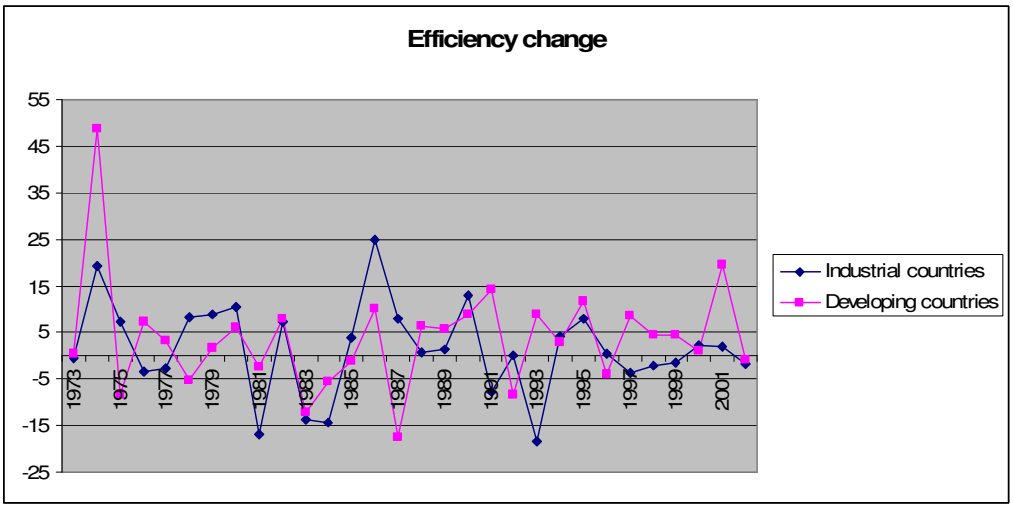

Figure 3: Efficiency Change Eolutions of Country Groups

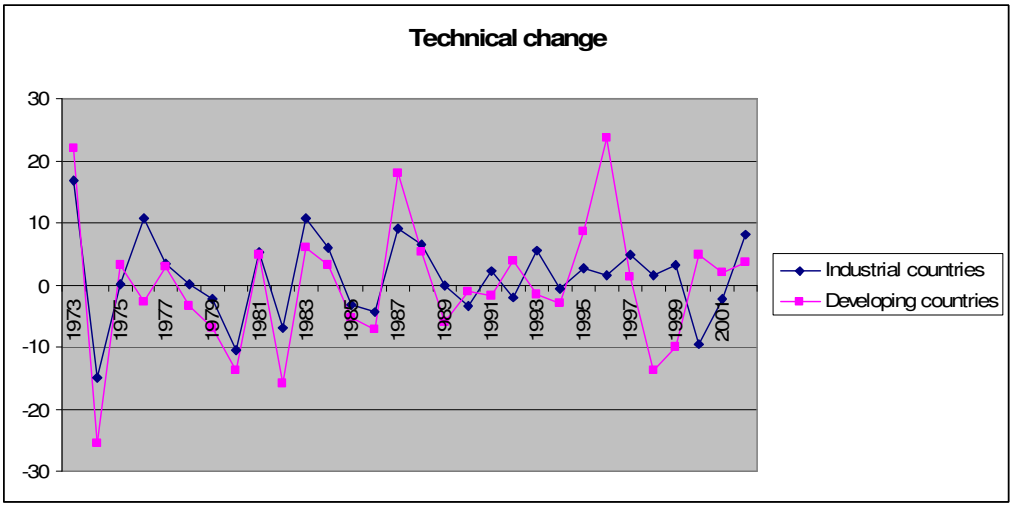

Figure 4: Technical Change Evolutions of Country Groups

When one examines the plot of the efficiency change index for the industrial and developing country groups, even though there is not an obviously

consistent pattern between the country groups' mean efficiency values, several years exist when the efficiency change index for these two groups tends to be changing in the opposite direction. Therefore, we investigated the correlations between the productivity indices for the two groups of countries. Results are presented in Table 14.

Table 14: Correlations Between Productivity Indices of Country Groups

		Malmquist	**Eff. ch.**	**Tech. ch.**
Wholep.	Corr. coef.	0.120	0.664	0.679
	P value	0.486	0.066	0.067
1st p.	Corr. coef.	0.380	0.334	0.905*
	P value	0.283	0.112	0.030
2nd p.	Corr. coef.	0.281	0.315	0.873*
	P value	0.122	0.409	0.042
3rd p.	Corr. coef.	-0.079*	-0.167	0.097
	P value	0.044	0.076	0.111

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The results of Table 14 verify our prediction and show a negative correlation between the Malmquist index patterns of the two groups in the last period.

As for the technical change index, especially for the first half of the sample, the developing countries showed declines in value but the changes were very similar to the technical change index values of the industrial countries. This similarity in the pattern of change breaks in the second half of the sample years, when the production of the automotive sector became more international and global production patterns start to emerge. This pattern is supported by the correlation values in Table 14 that show significant positive correlations between the country groups in the first and second periods.

Moreover, we investigated the equality of means of the countries' index values for the sub-periods. The results in Table 15 show there is no significant difference in the Malmquist index values for the countries and country groups in the sub-periods. Even though in the analysis above shows country period means are different, formal tests indicate that this differences are not statisticalyy significant. Results for the efficiency and technical change indices are reported in Tables 4 and 5 of Appendix C, respectively, and also show no significant difference for the sub-period means of the countries.

Table 15: Equality of Means for Sub-Periods of Malmquist Index (p values)

Industrial Countries	**1st period – 2nd period**	**2nd period - 3rd period**	**1st period - 3rd period**
Austria	0.077	0.105	0.751
Canada	0.497	0.832	0.346
Denmark	0.556	0.955	0.099
Finland	0.373	0.806	0.462
France	0.753	0.402	0.274
Germany	0.815	0.054	0.052
Greece	0.517	0.621	0.754
Italy	0.362	0.941	0.274
Japan	0.591	0.118	0.052
Netherlands	0.600	0.205	0.058
Norway	0.305	0.829	0.216
Portugal	0.231	0.517	0.698
Spain	0.804	0.364	0.390
Sweden	0.157	0.373	0.419
UK	0.444	0.500	0.984
USA	0.859	0.875	0.981
Industrial countries	**0.898**	**0.603**	**0.673**
Developing countries	**1st period -2nd period**	**2nd period - 3rd period**	**1st period - 3rd period**
Chile	0.776	0.208	0.656
Colombia	0.794	0.259	0.445
Ecuador	0.723	0.241	0.287
Hungary	0.716	0.084	0.167
India	0.635	0.583	0.817
Korea	0.766	0.911	0.849
Poland	0.476	0.137	0.292

Turkey	0.280	0.634	0.834
Venezuela	0.961	0.635	0.429
Zimbabwe	0.984	0.517	0.477
Developing countries	**0.823**	**0.695**	**0.857**

6.2. Comparisons with Labor Productivity Change

Since the best performing countries in terms of productivity changes are usually among the leading producers in the sector, we may have an incentive to think that top automotive producing countries are also the top countries in productivity change. But production is a relative concept; for example, larger countries tend to produce more automotive products. So it could be misleading to relate production to productivity. Instead, we wanted to compare productivity results, measured by the productivity change index and its components, with another productivity measure, namely, output per labor.

Output per labor, known as the measure of labor productivity, is a partial productivity measure as opposed to a total factor productivity measure, such as the Malmquist productivity change index. Thus, by calculating the annual percentage change in this productivity measure, we wanted to evaluate the performance of the Malmquist productivity change index compared to this partial measure.

Table 16 presents the summary of the changes in output per labor computed for each country and each year for the automotive sectors of the 26 countries over 30 years. The same data that were used in the computation of the linear programming problems for the Malmquist index are used in these computations.

These labor productivity change results lead us to reach similar conclusions to those derived previously from the Malmquist productivity change index.

Table 16: Labor Productivity Change (%)

Industrial countries	**1973-2002**	**1973-1982**	**1983-1992**	**1993-2002**
Spain	10.60	17.80	15.26	-1.27
Austria	9.54	11.96	13.99	2.67
Germany	8.19	13.06	11.05	0.47
Japan	8.18	12.19	12.14	0.22
Portugal	7.82	5.82	8.61	9.01
Greece	7.31	16.42	4.39	1.12
Canada	7.08	6.02	8.00	7.23
Finland	6.82	18.62	3.14	-1.29
Sweden	6.40	9.63	3.58	5.98
Norway	6.14	8.22	2.46	7.74
France	6.13	10.80	8.68	-1.06
Denmark	5.51	8.38	5.59	2.56
Italy	5.30	11.79	6.19	-2.06
UK	5.30	9.43	6.83	-3.37
USA	5.09	6.95	5.41	2.92
Netherlands	4.83	6.82	7.32	0.34
Mean	**6.89**	**10.87**	**7.67**	**1.95**
Developing Countries				
Ecuador	24.27	40.69	5.76	26.36
Korea	22.90	39.23	20.45	9.01
Venezuela	11.65	22.52	8.55	3.88
Colombia	11.20	24.14	-0.25	9.72
Turkey	10.35	11.49	14.07	5.48
Zimbabwe	8.48	6.92	5.92	12.60
Chile	8.20	4.35	17.79	2.47
India	6.70	11.40	2.05	6.64
Hungary	4.84	5.80	-7.27	15.99
Poland	3.73	8.31	-6.31	9.21
Developingcountries mean	**11.23**	**17.48**	**6.07**	**10.14**
TOTAL MEAN	**8.56**	**13.41**	**7.05**	**5.10**

The results indicate that output per labor increased more in developing countries than it did in industrial countries. In industrial countries, there is a significant decline in the percentage change of output per labor. In most of the industrial

countries, the change in output per labor is actually negative in the third decade of the sample, indicating that this group of countries, even with technological innovations, actually is unable to increase the output a worker can produce in the automotive sector. As a group, developing countries have experienced labor productivity increases for all the sub-periods in the sample, with the smallest increase in the second sub-period. This is also the period when the mean Malmquist productivity change value is lowest for developing countries.

Table 17 shows the rank correlations for the two productivity change indices, namely the partial productivity change measure of output per labor and the total factor productivity measure, the Malmquist productivity change index. The correlation table indicates there are significantly positive correlations between the country rankings of these productivity change measures for all countries in the sample and for the country groups. These results show that the best performing countries in terms of the Malmquist index are also best performers according to the labor productivity change measure. In fact, correlation coefficient results show significant correlations between the rankings of the two productivity change measures. As the results of the table illustrate, the correlations between the rankings obtained from the two alternative productivity change indices are significant for rankings for all countries and for rankings within the industrial and developing country groups, for most sub-periods.

Table 17: Labor and Malmquist Productivity Change Rank Correlations

Industrial countries				
		labor1stperiod	**labor2ndperiod**	**labor3rdperiod**
malmquist1stperiod	Corr.Coef.	**0.615**		
	p value	**0.011**		
malmquist2ndperiod	Corr.coef.		**0.626**	
	p value		**0.009**	
malmquist3rdperiod	Corr.coef.			
	p value			
Developing				
		labor1stperiod	**labor2ndperiod**	**labor3rdperiod**
malmquist1stperiod	Corr.coef.			
	p value			
malmquist2ndperiod	Corr.coef.		**0.745**	
	p value		**0.013**	
malmquist3rdperiod	Corr.coef.			**0.699**
	p value			**0.024**
all countries				
		labor1stperiod	**labor2ndperiod**	**labor3rdperiod**
malmquist1stperiod	Corr.coef.	**0.496**		
	p value	**0.010**		
malmquist2ndperiod	Corr.coef.		**0.720**	
	p value		**0.000**	
malmquist3rdperiod	Corr.coef.			**0.537**
	p value			**0.050**

The relationship between the productivity change indices can be seen with the aid of the figures below. We draw the evolution of labor productivity change and Malmquist productivity change after calculating the mean percentage change in the Malmquist index. The figures show the two alternative productivity change indices for industrial and developing country groups separately with two different scales.

As can be seen in the figures below, there is a very strong similarity in the variation of the productivity change measures computed using the two different methods.[17]

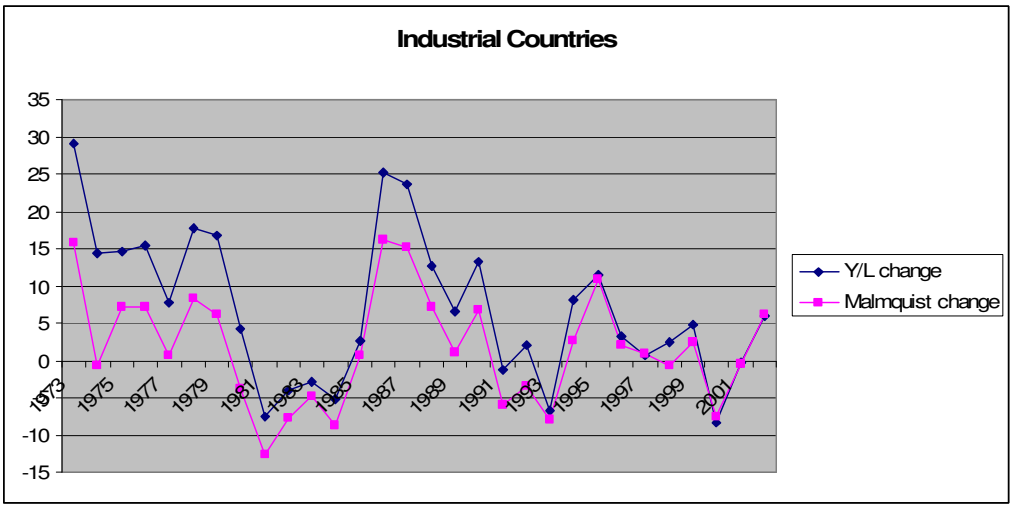

Figure 5: Productivity Change Indices for Industrial Countries

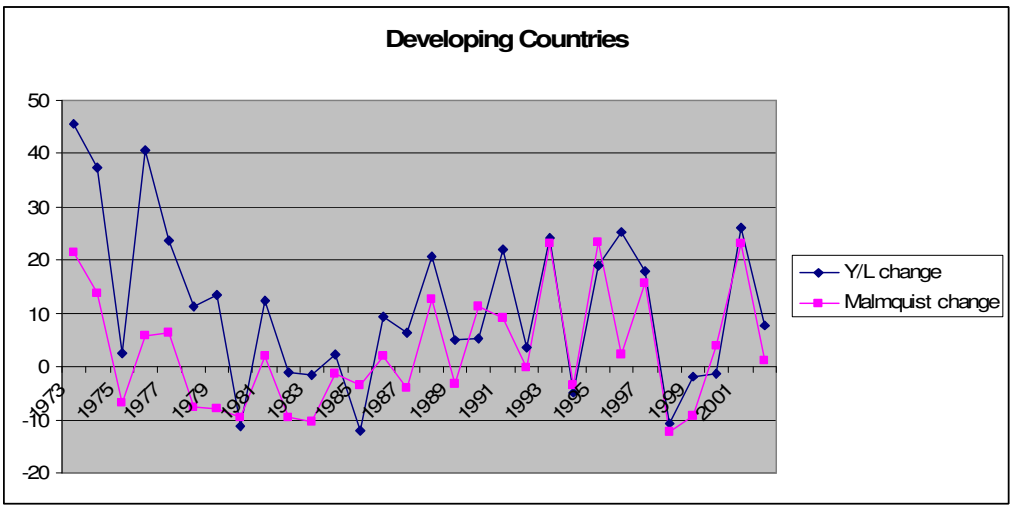

Figure 6: Productivity Change Indices for Developing Countries

[17] Since the contents of these two productivity change measures are very different, the scales should not be compared.

6.3. Turkey

As for the performance of the Turkish automotive sector compared to the performance of the other 25 sample countries, that country's the sector experienced deterioration in productivity of 2.1% on the average for the entire sample period. Table 18 presents the summary of Turkey's productivity performance. Its performance during the sub-sample periods are such that only in the second decade from 1983-1992, did the automotive sector have positive productivity gains and the loss in productivity was even larger in the first and the third decades compared to whole sample mean. During the sub-period from 1973-1982, which were the years of both economic and political turmoil, the productivity loss in the sector was 3.8% and for the 1993-2002 period, which coincides with major financial and economic crises, there was a 6.5% deterioration in productivity in the automotive sector.

Table 18: Productivity Performance of Turkey

	1973-2002	**1973-1982**	**1983-1992**	**1993-2002**
Malmquist	0.979	0.962	1.042	0.935
Efficiency change	0.994	1.010	1.035	0.940
Technical change	0.984	0.952	1.006	0.994

Hence, when one examines the sources of these productivity changes through the efficiency and technical change components, for the first two decades of the sample, we see positive mean efficiency scores, which indicates catching-up towards the best practice frontier. In the third decade, which includes the years of major financial crises, the automotive sector in Turkey had

a loss of 6% in terms of efficiency. The only period which showed positive productivity change due to technical change is a small one in the period 1983-1992, which is when major liberalization in the Turkish economy occurred.

Moreover, we investigated the relation of the Malmquist change, efficiency change and technical change components for Turkey. Figure 7 shows the results.

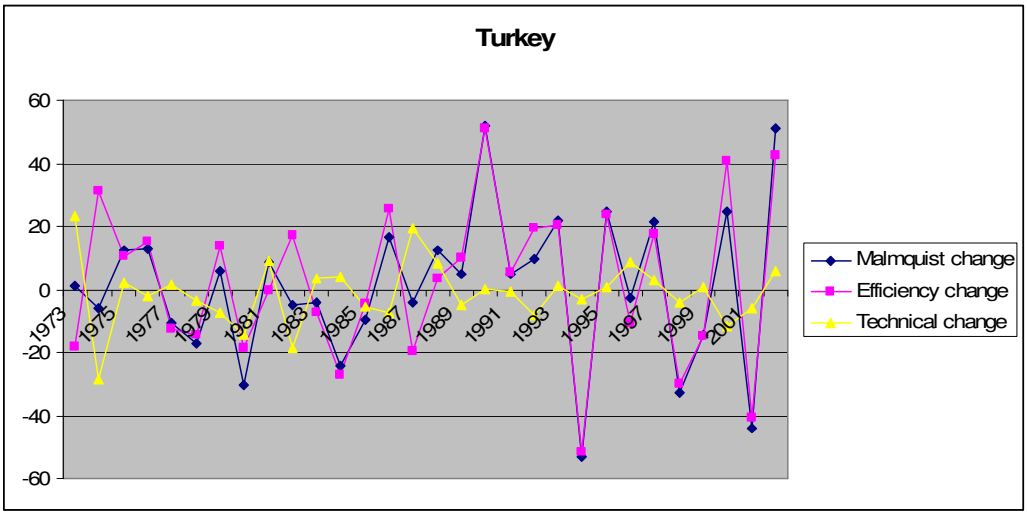

Figure 7: Malmquist Index and Components for Turkey

In the case of Turkey, change in labor productivity and Malmquist productivity coincides. Figure 8 shows the relationship between productivity change measures in the case for Turkey.

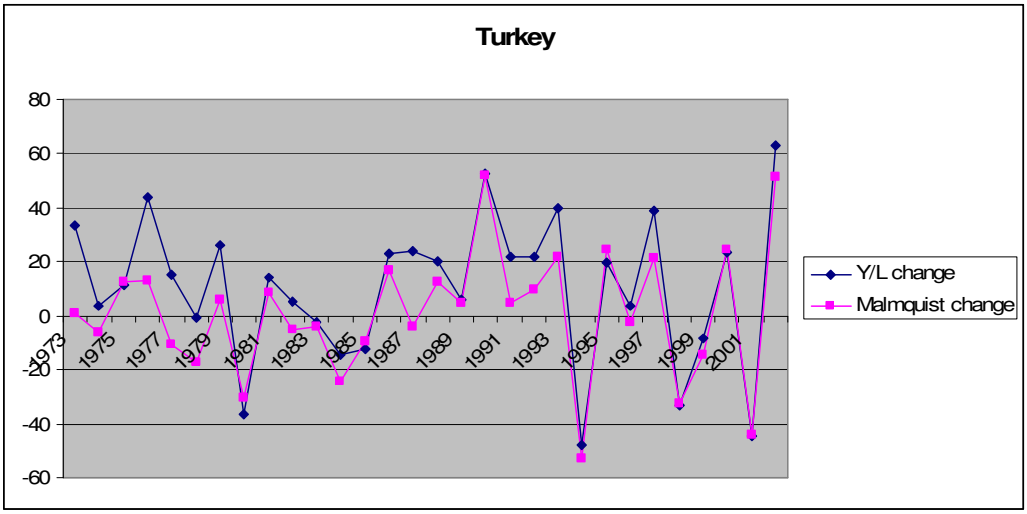

Figure 8: Labor and Malmquist Productivity Change in Turkey

As is the case for the country groups, for Turkey, the two productivity change measures give similar results regarding productivity change over the sample period. However, the magnitudes are different and in some periods, the signs of productivity change are different. Malmquist productivity change, which is a total factor productivity change measure, provides more insight into the changes in the production process.

CHAPTER VII

CONCLUSION

This paper investigates the productivity changes in the automotive sectors of 26 countries over the time period from 1973-2002 by dividing the sample into industrial and developing country groups. We have utilized the Malmquist productivity change index, which allows for technical inefficiency and technological regress or progress, computed by DEAP Version 2.1.

The one of the reasons for the popularity of the Malmquist index as a productivity change measure comes from its decomposability. Taking advantage of this feature of the Malmquist index, we found the reasons behind automotive sector productivity changes for industrial and developing country groups, which is the first research question stated in Chapter 1. Results show that the main source of automotive sector productivity improvement in industrial countries is innovation performance, which we computed by using the technical change component of the Malmquist index. In the case of developing countries, the productivity gains arise largerly from efficiency change, which indicates catching-up performance.

We applied the equality of means tests over the complete period and sub-period productivity means for both industrial and developing countries to find whether a significant difference between the productivity patterns in the country groups exists. Our findings indicate there is no significant difference between the productivity change, technical change and efficiency change means of industrial and developing countries.

To answer the question, we used Spearman's rank correlation coefficients and found that, although there is no correlation between the sub-period rankings of the developing countries' productivity change, technical change and efficiency change components, there are significant correlations among the technical change sub-period rankings for industrial countries. This shows that innovations in the sector usually emerge from the same countries.

Our sectoral analyses indicated that some developing countries showed important improvements in their automotive production and export shares in the last decades. We found that productivity patterns in these countries also have increased over the last decades. In fact, Malmquist index values show that developing countries exhibited a positive change in their productivity in the last sub-period after negative changes in the first two sub-periods. This result shows that the productivity improvement of developing countries coincides with the production and export share improvements for this group of countries. Moreover, we compared the results of the Malmquist index to a partial productivity change measure, labor productivity change. Correlation results show that the best performing countries in terms of the Malmquist index are also the best performers according to the labor productivity change. By using the

Malmquist index, which is a total factor productivity change measure, we take into account all inputs in the production process, which gives more reliable results compared to the partial measure of labor productivity change. Moreover, by means of the Malmquist index, we investigated the sources of productivity changes, which is not possible using the labor productivity change.

To examine the performance of the automotive sector of Turkey, we presented the automotive sector performance analyses of Turkey. Results showed that, on the average, the country could not demonstrate a good performance in terms of productivity change, catching-up and shift in the frontier. However, considering the components of productivity change, Turkey performed better in catching-up compared to shifts in the frontier, in line with the averages of developing countries. Considering the 26 countries in the sample, Turkey achieved the 18^{th} rank in terms of mean productivity changes for the period 1973-2002.

Further research can be done on the determinants of productivity growth in the sector. Depending upon the availability of data, the effects of foreign direct investment, R&D or trade on the productivity in the sector can be investigated. Results would make the interpretation of efficiency change and technical change evolutions easier.

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APPENDICES

APPENDIX A

SECTORAL SHARES IN TOTAL MANUFACTURING

Table 1: 1981 Production Shares

		austria	rank	canada	rank	chile	rank	colombia	rank	ecuador	rank	finland	rank
311	Food products	0.077	4	0.102	1	0.158	1	0.136	2	0.252	1	0.252	1
313	Beverages	0.030	15	0.029	14	0.055	3	0.144	1	0.064	4	0.064	4
314	Tobacco	0.051	7	0.008	21	0.045	6	0.024	14	0.034	10	0.034	10
321	Textiles	0.055	6	0.033	12	0.041	8	0.095	3	0.106	2	0.106	2
322	Wearing apparel. except footwear	0.027	16	0.029	13	0.020	15	0.033	10	0.015	17	0.015	17
323	Leather products	0.003	24	0.003	24	0.006	22	0.008	21	0.005	22	0.005	22
324	Footwear, except rubber or plastic	0.012	20	0.005	23	0.017	16	0.009	20	0.006	21	0.006	21
331	Wood products, except furniture	0.011	21	0.041	10	0.026	12	0.007	22	0.020	14	0.020	14
332	Furniture, except metal	0.034	13	0.018	16	0.006	21	0.004	24	0.022	12	0.022	12
341	Paper and products	0.039	10	0.086	3	0.048	5	0.032	11	0.038	8	0.038	8
342	Printing and publishing	0.038	11	0.052	7	0.049	4	0.029	13	0.028	11	0.028	11
351	Industrial chemicals	0.037	12	0.035	11	0.013	18	0.052	5	0.013	18	0.013	18
352	Other chemicals	0.033	14	0.047	8	0.076	2	0.064	4	0.063	5	0.063	5
355	Rubber products	0.014	19	0.014	19	0.010	19	0.018	16	0.016	16	0.016	16
356	Plastic products	0.018	17	0.017	17	0.013	17	0.019	15	0.036	9	0.036	9
362	Glass and products	0.014	18	0.007	22	0.007	20	0.011	19	0.012	19	0.012	19
369	Other non-metallic mineral products	0.050	8	0.025	15	0.041	7	0.035	8	0.062	6	0.062	6
371	Iron and steel	0.070	5	0.043	9	0.030	10	0.030	12	0.019	15	0.019	15
381	Fabricated metal products	0.080	3	0.070	5	0.040	9	0.038	6	0.069	3	0.069	3
382	Machinery, except electrical	0.109	1	0.076	4	0.021	14	0.017	17	0.004	23	0.004	23
383	Machinery, electric	0.103	2	0.062	6	0.022	13	0.034	9	0.039	7	0.039	7
384	Transport equipment	0.046	9	0.102	2	0.028	11	0.037	7	0.021	13	0.021	13
385	Professional & scientific equipment	0.007	23	0.008	20	0.001	24	0.005	23	0.007	20	0.007	20
390	Other manufactured products	0.008	22	0.016	18	0.002	23	0.012	18	0.004	24	0.004	24

Table 1 (cont'd),

		franc e	rank	german y	rank	greece	rank	hungary	ran k	india	rank	italy	rank	japan	ran k
311	Food products	0.108	2	0.053	6	0.129	2	0.097	2	0.078	5	0.067	5	0.077	4
313	Beverages	0.020	14	0.026	10	0.039	9	0.021	14	0.007	15	0.018	18	0.015	17
314	Tobacco	0.009	23	0.025	12	0.023	14	0.005	24	0.014	14	0.003	24	0.000	24
321	Textiles	0.036	9	0.027	9	0.144	1	0.064	5	0.167	1	0.067	6	0.043	9
322	Wearing apparel. except footwear	0.028	12	0.014	18	0.045	8	0.032	13	0.005	20	0.033	11	0.015	18
323	Leather products	0.004	24	0.003	24	0.008	21	0.009	23	0.003	22	0.008	23	0.003	22
324	Footwear. except rubber or plastic	0.009	22	0.004	23	0.014	18	0.016	17	0.003	23	0.015	19	0.002	23
331	Wood products. except furniture	0.017	18	0.012	20	0.019	17	0.012	20	0.005	19	0.012	20	0.022	14
332	Furniture. except metal	0.018	16	0.018	16	0.009	20	0.017	15	0.001	24	0.020	16	0.010	20
341	Paper and products	0.023	13	0.022	14	0.025	13	0.016	16	0.023	11	0.021	14	0.027	13
342	Printing and publishing	0.043	6	0.019	15	0.023	15	0.015	18	0.022	12	0.032	12	0.052	7
351	Industrial chemicals	0.039	8	0.065	5	0.032	11	0.063	6	0.075	6	0.063	7	0.038	10
352	Other chemicals	0.042	7	0.049	7	0.052	6	0.048	7	0.068	8	0.043	9	0.047	8
355	Rubber products	0.014	19	0.012	19	0.011	19	0.010	22	0.016	13	0.018	17	0.012	19
356	Plastic products	0.019	15	0.022	13	0.031	12	0.012	21	0.006	17	0.022	13	0.029	12
362	Glass and products	0.014	21	0.009	21	0.008	22	0.013	19	0.006	18	0.012	21	0.009	21
369	Other non-metallic mineral products	0.035	10	0.026	11	0.067	4	0.033	12	0.030	9	0.038	10	0.037	11
371	Iron and steel	0.034	11	0.048	8	0.032	10	0.044	9	0.137	2	0.070	4	0.070	5
381	Fabricated metal products	0.074	5	0.069	4	0.062	5	0.035	11	0.030	10	0.060	8	0.066	6
382	Machinery. except electrical	0.103	3	0.145	1	0.020	16	0.089	3	0.087	4	0.102	2	0.120	2
383	Machinery. electric	0.091	4	0.118	2	0.051	7	0.118	1	0.075	7	0.086	3	0.126	1
384	Transport equipment	0.113	1	0.117	3	0.082	3	0.085	4	0.091	3	0.109	1	0.104	3
385	Professional & scientific equipment	0.014	20	0.017	17	0.001	24	0.048	8	0.007	16	0.021	15	0.018	15
390	Other manufactured products	0.017	17	0.006	22	0.005	23	0.041	10	0.004	21	0.009	22	0.016	16

Table 1 (cont'd),

		korea	rank	netherlands	rank	norway	rank	polan d	rank	portugal	rank	zimbabwe	rank
311	Food products	0.070	4	0.153	1	0.101	3	0.000	24	0.108	2	0.128	1
313	Beverages	0.031	13	0.038	11	0.034	11	0.172	1	0.030	14	0.059	5
314	Tobacco	0.057	6	0.043	9	0.022	14	0.005	23	0.013	20	0.036	10
321	Textiles	0.131	1	0.026	14	0.022	15	0.135	3	0.150	1	0.102	2
322	Wearing apparel. except footwear	0.051	7	0.009	19	0.011	18	0.035	9	0.034	13	0.058	6
323	Leather products	0.010	20	0.002	22	0.002	24	0.008	21	0.008	22	0.003	23
324	Footwear. except rubber or plastic	0.006	23	0.003	21	0.002	23	0.020	13	0.017	17	0.027	14
331	Wood products. except furniture	0.011	19	0.015	16	0.061	7	0.022	12	0.043	8	0.026	16
332	Furniture. except metal	0.004	24	0.011	17	0.021	16	0.026	11	0.014	19	0.020	19
341	Paper and products	0.022	15	0.030	13	0.051	8	0.011	20	0.054	7	0.023	17
342	Printing and publishing	0.020	17	0.073	5	0.075	4	0.007	22	0.038	10	0.041	9
351	Industrial chemicals	0.050	8	0.096	3	0.044	9	0.037	8	0.021	16	0.043	8
352	Other chemicals	0.044	9	0.042	10	0.026	13	0.044	7	0.041	9	0.054	7
355	Rubber products	0.027	14	0.008	20	0.005	21	0.013	18	0.011	21	0.021	18
356	Plastic products	0.019	18	0.018	15	0.018	17	0.018	14	0.025	15	0.019	20
362	Glass and products	0.008	22	0.033	12	0.006	19	0.014	17	0.015	18	0.006	22
369	Other non-metallic mineral products	0.037	10	0.000	24	0.032	12	0.013	19	0.057	5	0.035	11
371	Iron and steel	0.072	3	0.051	8	0.037	10	0.033	10	0.037	11	0.091	4
381	Fabricated metal products	0.036	11	0.069	6	0.065	6	0.064	6	0.055	6	0.097	3
382	Machinery. except electrical	0.034	12	0.083	4	0.113	1	0.171	2	0.036	12	0.026	15
383	Machinery. electric	0.086	2	0.122	2	0.071	5	0.078	5	0.057	4	0.031	12
384	Transport equipment	0.070	5	0.061	7	0.108	2	0.113	4	0.059	3	0.029	13
385	Professional & scientific equipment	0.009	21	0.009	18	0.004	22	0.016	16	0.003	23	0.001	24
390	Other manufactured products	0.020	16	0.001	23	0.006	20	0.017	15	0.003	24	0.012	21

Table 1 (cont'd),

		spain	rank	turkey	rank	sweden	rank	denmark	rank	UK	rank	USA	rank	venezuela	rank
311	Food products	0.113	1	0.104	2	0.092	4	0.200	1	0.098	3	0.082	4	0.108	1
313	Beverages	0.040	10	0.029	12	0.010	17	0.042	9	0.034	10	0.015	17	0.073	2
314	Tobacco	0.015	19	0.042	8	0.004	22	0.009	20	0.013	18	0.008	22	0.035	8
321	Textiles	0.053	8	0.111	1	0.017	13	0.032	11	0.032	11	0.029	12	0.028	13
322	Wearing apparel. except footwear	0.028	13	0.007	18	0.009	19	0.016	18	0.020	15	0.026	13	0.026	15
323	Leather products	0.007	23	0.003	20	0.002	23	0.002	24	0.003	24	0.002	24	0.004	23
324	Footwear. except rubber or plastic	0.014	20	0.003	20	0.002	23	0.005	23	0.006	23	0.004	23	0.016	17
331	Wood products. except furniture	0.023	16	0.007	19	0.058	8	0.019	15	0.014	17	0.015	18	0.008	21
332	Furniture. except metal	0.024	15	0.002	22	0.012	16	0.022	14	0.016	16	0.013	19	0.013	18
341	Paper and products	0.026	14	0.014	14	0.085	6	0.026	12	0.030	13	0.039	10	0.031	9
342	Printing and publishing	0.029	12	0.012	15	0.060	7	0.061	4	0.064	5	0.059	6	0.028	12
351	Industrial chemicals	0.036	11	0.043	7	0.030	11	0.048	8	0.052	7	0.050	7	0.027	14
352	Other chemicals	0.052	9	0.035	9	0.039	10	0.053	7	0.047	8	0.047	8	0.060	3
355	Rubber products	0.019	18	0.015	13	0.009	18	0.008	21	0.013	20	0.012	20	0.012	19
356	Plastic products	0.022	17	0.009	17	0.012	15	0.019	16	0.023	14	0.020	15	0.031	10
362	Glass and products	0.013	21	0.011	16	0.005	20	0.008	22	0.008	22	0.009	21	0.010	20
369	Other non-metallic mineral products	0.055	7	0.049	4	0.025	12	0.041	10	0.032	12	0.020	14	0.036	7
371	Iron and steel	0.061	6	0.060	3	0.050	9	0.013	19	0.038	9	0.040	9	0.038	6
381	Fabricated metal products	0.073	3	0.029	11	0.085	5	0.062	3	0.062	6	0.067	5	0.045	5
382	Machinery. except electrical	0.071	4	0.043	6	0.133	1	0.132	2	0.123	1	0.138	1	0.023	16
383	Machinery. electric	0.069	5	0.035	10	0.094	3	0.057	6	0.093	4	0.098	3	0.029	11
384	Transport equipment	0.084	2	0.047	5	0.121	2	0.059	5	0.109	2	0.105	2	0.049	4
385	Professional & scientific equipment	0.004	24	0.001	24	0.013	14	0.025	13	0.013	18	0.038	11	0.003	24
390	Other manufactured products	0.011	22	0.002	23	0.005	21	0.018	17	0.010	21	0.016	16	0.006	22

Table 2: 1990 Production Shares

		austria	rank	canada	rank	chile	rank	colombia	rank	ecuador	rank	finland	rank	france	rank
311	Food products	0.074	4	0.113	2	0.176	2	0.166	1	0.191	1	0.095	3	0.100	3
313	Beverages	0.027	15	0.026	13	0.043	5	0.118	2	0.028	8	0.025	12	0.021	14
314	Tobacco	0.045	7	0.009	20	0.035	8	0.022	14	0.001	24	0.007	19	0.007	22
321	Textiles	0.041	9	0.027	12	0.038	7	0.104	3	0.079	2	0.014	16	0.030	9
322	Wearing apparel. except footwear	0.017	16	0.025	15	0.019	15	0.028	12	0.009	15	0.016	14	0.023	13
323	Leather products	0.003	24	0.001	24	0.004	22	0.008	21	0.003	19	0.002	24	0.004	24
324	Footwear. except rubber or plastic	0.007	23	0.003	23	0.014	18	0.013	18	0.005	18	0.003	23	0.006	23
331	Wood products. except furniture	0.028	14	0.040	10	0.031	9	0.007	23	0.013	14	0.059	7	0.016	17
332	Furniture. except metal	0.032	13	0.020	17	0.006	20	0.005	24	0.008	16	0.019	13	0.016	19
341	Paper and products	0.043	8	0.078	3	0.064	4	0.038	8	0.029	7	0.134	1	0.027	11
342	Printing and publishing	0.037	11	0.068	4	0.026	11	0.027	13	0.022	10	0.078	4	0.049	6
351	Industrial chemicals	0.041	10	0.043	9	0.028	10	0.066	5	0.015	12	0.051	9	0.042	8
352	Other chemicals	0.034	12	0.056	8	0.070	3	0.076	4	0.063	3	0.026	11	0.049	7
355	Rubber products	0.010	20	0.012	19	0.008	19	0.017	15	0.014	13	0.005	22	0.013	20
356	Plastic products	0.017	17	0.026	14	0.020	13	0.028	11	0.035	6	0.016	15	0.026	12
362	Glass and products	0.017	18	0.006	22	0.006	21	0.014	17	0.007	17	0.006	21	0.012	21
369	Other non-metallic mineral products	0.047	6	0.025	16	0.025	12	0.043	6	0.050	4	0.039	10	0.029	10
372	Non-ferrous metals	0.014	19	0.029	11	0.196	1	0.007	22	0.002	23	0.013	17	0.018	15
381	Fabricated metal products	0.081	3	0.058	7	0.042	6	0.035	9	0.037	5	0.065	6	0.078	5
382	Machinery. except electrical	0.105	2	0.068	5	0.019	14	0.016	16	0.002	22	0.124	2	0.097	4
383	Machinery. electric	0.125	1	0.067	6	0.014	17	0.034	10	0.027	9	0.068	5	0.101	2
384	Transport equipment	0.053	5	0.126	1	0.017	16	0.042	7	0.018	11	0.052	8	0.112	1
385	Professional & scientific equipment	0.007	22	0.008	21	0.001	24	0.009	20	0.002	21	0.013	18	0.016	18
390	Other manufactured products	0.008	21	0.015	18	0.002	23	0.011	19	0.003	20	0.006	20	0.017	16

Table 2 (cont'd),

		germany	rank	greece	ran	hungar y	rank	india	rank	italy	ran	japan	rank	korea	ran
311	Food products	0.053	6	0.144	1	0.106	2	0.088	3	0.066	5	0.075	4	0.060	5
313	Beverages	0.022	12	0.051	7	0.024	14	0.010	17	0.014	17	0.012	19	0.019	16
314	Tobacco	0.024	10	0.030	13	0.006	23	0.019	13	0.004	24	0.002	22	0.028	12
321	Textiles	0.022	13	0.118	2	0.043	7	0.130	1	0.071	4	0.030	10	0.068	4
322	Wearing apparel. except footwear	0.011	20	0.059	5	0.031	10	0.013	15	0.034	9	0.013	17	0.034	10
323	Leather products	0.002	24	0.007	21	0.005	24	0.005	19	0.009	23	0.002	23	0.011	19
324	Footwear. except rubber or plastic	0.002	23	0.011	18	0.012	20	0.004	21	0.015	16	0.002	24	0.006	24
331	Wood products. except furniture	0.012	19	0.019	17	0.013	19	0.004	22	0.011	22	0.016	13	0.009	23
332	Furniture. except metal	0.015	16	0.010	19	0.017	17	0.000	24	0.020	14	0.010	20	0.010	22
341	Paper and products	0.025	9	0.029	15	0.018	16	0.023	11	0.027	13	0.025	12	0.021	15
342	Printing and publishing	0.019	14	0.031	12	0.027	13	0.014	14	0.043	7	0.054	6	0.025	14
351	Industrial chemicals	0.066	5	0.031	11	0.058	5	0.073	6	0.041	8	0.043	8	0.042	8
352	Other chemicals	0.052	7	0.067	4	0.062	4	0.066	7	0.027	12	0.052	7	0.049	7
355	Rubber products	0.012	18	0.009	20	0.011	22	0.023	12	0.016	15	0.013	18	0.031	11
356	Plastic products	0.032	8	0.029	14	0.021	15	0.012	16	0.033	10	0.035	9	0.027	13
362	Glass and products	0.009	21	0.005	22	0.012	21	0.004	20	0.012	21	0.009	21	0.010	21
369	Other non-metallic mineral products	0.022	11	0.068	3	0.028	12	0.045	8	0.030	11	0.030	11	0.037	9
372	Non-ferrous metals	0.014	17	0.037	10	0.029	11	0.026	9	0.012	19	0.013	16	0.012	18
381	Fabricated metal products	0.073	4	0.048	8	0.039	9	0.024	10	0.055	6	0.071	5	0.051	6
382	Machinery. except electrical	0.154	1	0.019	16	0.108	1	0.080	4	0.140	1	0.142	2	0.070	3
383	Machinery. electric	0.136	2	0.047	9	0.095	3	0.080	5	0.104	2	0.150	1	0.150	1
384	Transport equipment	0.126	3	0.052	6	0.057	6	0.095	2	0.101	3	0.107	3	0.102	2
385	Professional & scientific equipment	0.015	15	0.002	24	0.042	8	0.007	18	0.012	20	0.014	15	0.011	20
390	Other manufactured products	0.005	22	0.005	23	0.014	18	0.004	23	0.013	18	0.015	14	0.018	17

Table 2 (cont'd),

		netherland s	rank	norway	rank	poland	rank	portugal	rank	zimbab we	rank	spain	rank
311	Food products	0.134	1	0.097	3	0.113	2	0.087	2	0.106	3	0.123	1
313	Beverages	0.033	11	0.049	10	0.080	4	0.023	16	0.135	1	0.046	9
314	Tobacco	0.041	8	0.035	12	0.016	13	0.039	7	0.034	11	0.010	20
321	Textiles	0.022	14	0.014	17	0.053	6	0.110	1	0.114	2	0.038	11
322	Wearing apparel. except footwear	0.005	20	0.004	21	0.019	12	0.066	3	0.046	7	0.026	13
323	Leather products	0.002	23	0.001	23	0.005	24	0.008	21	0.003	23	0.007	23
324	Footwear. except rubber or plastic	0.002	22	0.001	24	0.011	18	0.030	14	0.030	12	0.009	22
331	Wood products. except furniture	0.011	15	0.046	11	0.014	15	0.035	10	0.019	16	0.025	14
332	Furniture. except metal	0.008	16	0.017	16	0.013	16	0.016	18	0.014	19	0.018	16
341	Paper and products	0.036	10	0.058	7	0.015	14	0.038	9	0.029	13	0.024	15
342	Printing and publishing	0.071	5	0.102	2	0.007	23	0.035	12	0.042	8	0.050	8
351	Industrial chemicals	0.124	2	0.060	6	0.046	8	0.029	15	0.052	6	0.039	10
352	Other chemicals	0.041	9	0.029	13	0.028	10	0.032	13	0.057	5	0.064	5
355	Rubber products	0.006	19	0.004	22	0.009	21	0.004	23	0.016	18	0.017	17
356	Plastic products	0.029	12	0.021	15	0.012	17	0.016	17	0.021	15	0.028	12
362	Glass and products	0.008	17	0.006	20	0.010	20	0.012	19	0.004	22	0.013	19
369	Other non-metallic mineral products	0.023	13	0.027	14	0.026	11	0.048	6	0.024	14	0.055	7
372	Non-ferrous metals	0.000	24	0.061	5	0.041	9	0.005	22	0.006	20	0.015	18
381	Fabricated metal products	0.064	6	0.058	8	0.047	7	0.055	5	0.061	4	0.062	6
382	Machinery. except electrical	0.079	4	0.118	1	0.113	1	0.035	11	0.019	17	0.066	4
383	Machinery. electric	0.117	3	0.056	9	0.062	5	0.056	4	0.039	9	0.068	3
384	Transport equipment	0.055	7	0.076	4	0.081	3	0.039	8	0.036	10	0.118	2
385	Professional & scientific equipment	0.007	18	0.006	19	0.008	22	0.002	24	0.001	24	0.004	24
390	Other manufactured products	0.002	21	0.007	18	0.011	19	0.009	20	0.006	21	0.010	21

Table 2 (cont'd),

		turkey	rank	swede n	rank	denmark	rank	uk	rank	usa	rank	venezuela	rank
311	Food products	0.088	2	0.083	5	0.177	1	0.099	3	0.091	3	0.099	1
313	Beverages	0.031	12	0.014	14	0.033	10	0.026	13	0.016	16	0.048	4
314	Tobacco	0.040	9	0.005	20	0.009	19	0.009	21	0.017	15	0.022	10
321	Textiles	0.112	1	0.012	16	0.027	15	0.028	12	0.026	12	0.024	7
322	Wearing apparel. except footwear	0.033	10	0.004	21	0.011	18	0.018	14	0.019	13	0.013	16
323	Leather products	0.002	24	0.001	23	0.001	24	0.002	24	0.002	24	0.003	22
324	Footwear. except rubber or plastic	0.002	23	0.001	24	0.003	23	0.005	23	0.002	23	0.007	19
331	Wood products. except furniture	0.006	19	0.059	8	0.021	17	0.013	17	0.016	17	0.003	24
332	Furniture. except metal	0.003	22	0.011	17	0.028	11	0.018	15	0.013	20	0.005	20
341	Paper and products	0.019	14	0.088	3	0.027	13	0.032	11	0.043	10	0.023	9
342	Printing and publishing	0.015	17	0.061	7	0.069	4	0.077	5	0.078	5	0.015	14
351	Industrial chemicals	0.049	7	0.039	10	0.048	8	0.056	8	0.056	8	0.036	5
352	Other chemicals	0.050	5	0.049	9	0.067	5	0.058	7	0.062	6	0.054	3
355	Rubber products	0.016	16	0.008	18	0.005	20	0.012	18	0.010	21	0.011	17
356	Plastic products	0.011	18	0.015	13	0.028	12	0.032	10	0.028	11	0.018	12
362	Glass and products	0.018	15	0.006	19	0.005	21	0.008	22	0.008	22	0.009	18
369	Other non-metallic mineral products	0.047	8	0.022	12	0.041	9	0.035	9	0.018	14	0.024	8
372	Non-ferrous metals	0.020	13	0.012	15	0.003	22	0.011	19	0.013	19	0.065	2
381	Fabricated metal products	0.031	11	0.086	4	0.080	3	0.059	6	0.053	9	0.028	6
382	Machinery. except electrical	0.049	6	0.121	2	0.133	2	0.118	1	0.110	2	0.015	15
383	Machinery. electric	0.051	4	0.078	6	0.057	6	0.088	4	0.085	4	0.020	11
384	Transport equipment	0.060	3	0.126	1	0.049	7	0.114	2	0.117	1	0.016	13
385	Professional & scientific equipment	0.003	20	0.023	11	0.027	14	0.014	16	0.058	7	0.003	23
390	Other manufactured products	0.003	21	0.003	22	0.021	16	0.011	19	0.014	18	0.005	21

Table 3: 2000 Production Shares

		austria	rank	canada	rank	chile	rank	colombi a	rank	finland	rank	france	rank
311	Food products	0.066	5	0.084	2	0.204	1	0.199	1	0.053	6	0.106	2
313	Beverages	0.000	21	0.023	14	0.073	3	0.097	3	0.000	21	0.022	14
314	Tobacco	0.000	21	0.009	21	0.037	6	0.008	19	0.000	21	0.000	24
321	Textiles	0.020	14	0.017	16	0.016	15	0.051	6	0.010	14	0.021	15
322	Wearing apparel. except footwear	0.000	21	0.016	17	0.013	16	0.046	8	0.006	16	0.015	19
323	Leather products	0.002	20	0.002	23	0.002	22	0.005	23	0.001	20	0.004	22
324	Footwear. except rubber or plastic	0.004	19	0.001	24	0.008	20	0.007	21	0.002	19	0.004	23
331	Wood products. except furniture	0.044	7	0.053	7	0.036	7	0.005	22	0.048	7	0.017	17
332	Furniture. except metal	0.037	11	0.035	10	0.007	21	0.008	18	0.017	13	0.018	16
341	Paper and products	0.047	6	0.078	3	0.064	5	0.051	5	0.191	2	0.024	12
342	Printing and publishing	0.044	9	0.027	13	0.027	11	0.033	10	0.055	5	0.051	7
351	Industrial chemicals	0.000	21	0.035	9	0.066	4	0.047	7	0.034	8	0.037	8
352	Other chemicals	0.040	10	0.040	8	0.076	2	0.115	2	0.019	12	0.084	6
355	Rubber products	0.007	18	0.010	19	0.009	18	0.007	20	0.006	17	0.016	18
356	Plastic products	0.036	12	0.029	11	0.034	10	0.038	9	0.028	9	0.034	10
362	Glass and products	0.018	15	0.005	22	0.008	19	0.012	17	0.009	15	0.013	20
369	Other non-metallic mineral products	0.035	13	0.022	15	0.035	8	0.062	4	0.000	21	0.022	13
371	Iron and steel	0.044	8	0.029	12	0.023	12	0.033	11	0.000	21	0.025	11
381	Fabricated metal products	0.088	3	0.063	6	0.035	9	0.024	12	0.061	4	0.093	4
382	Machinery. except electrical	0.119	2	0.077	4	0.018	14	0.018	15	0.112	3	0.091	5
383	Machinery. electric	0.121	1	0.075	5	0.011	17	0.018	14	0.248	1	0.094	3
384	Transport equipment	0.067	4	0.196	1	0.022	13	0.020	13	0.026	10	0.127	1
385	Professional & scientific equipment	0.018	16	0.016	18	0.001	24	0.000	24	0.024	11	0.037	9
390	Other manufactured products	0.016	17	0.009	20	0.001	23	0.014	16	0.006	18	0.010	21

Table 3 (cont'd),

		hungary	rank	india	rank	italy	rank	japan	rank	korea	rank	norway	rank	poland	rank
311	Food products	0.116	3	0.095	3	0.071	4	0.087	4	0.055	4	0.142	1	0.107	1
313	Beverages	0.023	12	0.013	17	0.012	20	0.021	14	0.017	15	0.020	15	0.080	2
314	Tobacco	0.009	20	0.024	12	0.002	24	0.007	22	0.011	19	0.000	24	0.055	6
321	Textiles	0.020	13	0.097	2	0.055	7	0.019	15	0.050	7	0.011	17	0.025	17
322	Wearing apparel. except footwear	0.030	8	0.021	13	0.040	9	0.008	21	0.020	14	0.003	20	0.032	14
323	Leather products	0.002	24	0.002	23	0.012	21	0.002	23	0.005	23	0.001	22	0.003	24
324	Footwear. except rubber or plastic	0.008	22	0.005	21	0.018	18	0.002	24	0.005	24	0.001	23	0.006	23
331	Wood products. except furniture	0.014	16	0.002	24	0.023	16	0.013	17	0.006	22	0.038	9	0.037	11
332	Furniture. except metal	0.010	18	0.003	22	0.032	12	0.009	19	0.008	20	0.026	12	0.031	15
341	Paper and products	0.017	14	0.026	11	0.022	17	0.027	12	0.022	13	0.046	8	0.020	18
342	Printing and publishing	0.030	10	0.017	16	0.040	10	0.060	7	0.025	12	0.103	3	0.048	8
351	Industrial chemicals	0.039	7	0.130	1	0.023	15	0.039	8	0.055	5	0.048	7	0.028	16
352	Other chemicals	0.062	5	0.081	5	0.055	6	0.065	6	0.041	9	0.032	10	0.037	10
355	Rubber products	0.009	19	0.017	15	0.011	22	0.012	18	0.011	16	0.002	21	0.011	21
356	Plastic products	0.030	9	0.017	14	0.035	11	0.038	9	0.029	10	0.017	16	0.033	13
362	Glass and products	0.009	21	0.005	20	0.010	23	0.008	20	0.011	18	0.006	19	0.016	20
369	Other non-metallic mineral products	0.029	11	0.049	9	0.041	8	0.027	11	0.026	11	0.028	11	0.045	9
371	Iron and steel	0.015	15	0.082	4	0.026	14	0.036	10	0.052	6	0.022	14	0.036	12
381	Fabricated metal products	0.052	6	0.027	10	0.122	2	0.072	5	0.041	8	0.058	6	0.066	5
382	Machinery. except electrical	0.083	4	0.068	6	0.139	1	0.133	2	0.113	3	0.075	4	0.074	3
383	Machinery. electric	0.153	1	0.057	8	0.074	3	0.151	1	0.209	1	0.059	5	0.051	7
384	Transport equipment	0.132	2	0.066	7	0.060	5	0.105	3	0.131	2	0.127	2	0.067	4
385	Professional & scientific equipment	0.012	17	0.009	19	0.026	13	0.026	13	0.011	17	0.023	13	0.020	19
390	Other manufactured products	0.004	23	0.010	18	0.013	19	0.014	16	0.008	21	0.007	18	0.009	22

Table 3 (cont'd),

		portugal	rank	spain	rank	turkey	rank	sweden	rank	denmark	rank	uk	rank	usa	rank
311	Food products	0.089	1	0.102	2	0.118	1	0.060	7	0.574	1	0.087	5	0.109	4
313	Beverages	0.032	15	0.035	10	0.025	13	0.010	16	0.029	3	0.021	15	0.018	18
314	Tobacco	0.006	22	0.006	23	0.030	12	0.003	20	0.002	20	0.009	21	0.024	13
321	Textiles	0.076	2	0.029	15	0.000	24	0.008	17	0.020	5	0.023	13	0.023	14
322	Wearing apparel. except footwear	0.069	6	0.023	17	0.054	6	0.001	22	0.003	17	0.014	19	0.014	19
323	Leather products	0.004	23	0.005	24	0.004	21	0.001	23	0.001	23	0.002	24	0.002	22
324	Footwear. except rubber or plastic	0.034	14	0.009	21	0.004	22	0.000	24	0.003	19	0.003	23	0.001	23
331	Wood products. except furniture	0.042	11	0.024	16	0.009	19	0.044	9	0.007	9	0.016	17	0.019	16
332	Furniture. except metal	0.034	13	0.031	13	0.013	18	0.010	15	0.005	13	0.025	12	0.027	11
341	Paper and products	0.053	10	0.031	14	0.020	15	0.085	5	0.016	7	0.028	11	0.045	9
342	Printing and publishing	0.053	9	0.058	6	0.041	9	0.048	8	0.006	11	0.103	2	0.000	24
351	Industrial chemicals	0.020	17	0.038	9	0.034	11	0.039	12	0.007	10	0.032	10	0.049	8
352	Other chemicals	0.035	12	0.058	7	0.083	3	0.073	6	0.041	2	0.072	7	0.088	5
355	Rubber products	0.002	24	0.016	18	0.018	17	0.006	18	0.004	15	0.009	20	0.011	20
356	Plastic products	0.024	16	0.031	12	0.024	14	0.011	14	0.017	6	0.044	8	0.044	10
362	Glass and products	0.014	19	0.011	20	0.019	16	0.004	19	0.001	22	0.009	22	0.009	21
369	Other non-metallic mineral products	0.072	3	0.063	5	0.049	8	0.014	13	0.026	4	0.022	14	0.025	12
371	Iron and steel	0.015	18	0.034	11	0.054	7	0.042	10	0.006	12	0.016	16	0.022	15
381	Fabricated metal products	0.069	5	0.097	3	0.035	10	0.088	4	0.016	8	0.085	6	0.084	6
382	Machinery. except electrical	0.057	8	0.074	4	0.060	4	0.094	3	0.003	16	0.102	3	0.120	3
383	Machinery. electric	0.061	7	0.053	8	0.057	5	0.151	1	0.003	18	0.101	4	0.140	1
384	Transport equipment	0.071	4	0.102	1	0.084	2	0.144	2	0.004	14	0.108	1	0.128	2
385	Professional & scientific equipment	0.008	21	0.012	19	0.002	23	0.040	11	0.000	24	0.036	9	0.061	7
390	Other manufactured products	0.008	20	0.009	22	0.007	20	0.003	21	0.002	21	0.015	18	0.018	17

Table 4: 1981 Employment Shares

		Austria	rank	Canada	rank	Chile	rank	Colombia	rank	Ecuador	rank	Finland	rank	France	rank
311	Food products	0.078	5	0.106	1	0.199	1	0.149	1	0.238	1	0.101	2	0.091	4
313	Beverages	0.021	15	0.018	18	0.041	8	0.055	5	0.047	6	0.011	18	0.010	22
314	Tobacco	0.003	24	0.005	23	0.006	22	0.008	23	0.011	17	0.003	24	0.002	24
321	Textiles	0.073	6	0.044	10	0.103	2	0.130	2	0.152	2	0.042	10	0.058	6
322	Wearing apparel. except footwear	0.051	7	0.055	9	0.054	7	0.101	3	0.033	12	0.062	7	0.043	8
323	Leather products	0.005	23	0.004	24	0.009	19	0.015	18	0.009	19	0.005	23	0.006	23
324	Footwear. except rubber or plastic	0.020	17	0.010	21	0.028	13	0.021	16	0.009	18	0.015	16	0.014	19
331	Wood products. except furniture	0.011	20	0.058	7	0.062	4	0.012	22	0.034	10	0.084	4	0.022	16
332	Furniture. except metal	0.042	9	0.028	13	0.014	18	0.013	21	0.033	13	0.025	14	0.022	15
341	Paper and products	0.032	12	0.068	5	0.032	11	0.023	15	0.034	11	0.095	3	0.023	13
342	Printing and publishing	0.038	11	0.058	7	0.039	9	0.041	9	0.036	9	0.069	6	0.042	9
351	Industrial chemicals	0.032	13	0.019	17	0.009	20	0.030	12	0.012	16	0.027	13	0.029	11
352	Other chemicals	0.028	14	0.034	12	0.056	5	0.048	6	0.053	4	0.020	15	0.035	10
355	Rubber products	0.013	18	0.015	19	0.016	17	0.018	17	0.012	15	0.009	20	0.020	18
356	Plastic products	0.020	16	0.021	16	0.022	16	0.030	11	0.042	8	0.013	17	0.023	14
362	Glass and products	0.013	19	0.006	22	0.009	21	0.014	20	0.008	22	0.007	22	0.013	21
369	Other non-metallic mineral products	0.039	10	0.023	14	0.026	14	0.042	8	0.046	7	0.030	11	0.025	12
371	Iron and steel	0.083	4	0.039	11	0.034	10	0.029	14	0.009	20	0.028	12	0.051	7
381	Fabricated metal products	0.092	3	0.075	4	0.067	3	0.063	4	0.071	3	0.059	8	0.079	5
382	Machinery. except electrical	0.104	2	0.080	3	0.054	6	0.029	13	0.008	21	0.124	1	0.102	3
383	Machinery. electric	0.112	1	0.064	6	0.024	15	0.034	10	0.048	5	0.059	9	0.103	2
384	Transport equipment	0.047	8	0.095	2	0.030	12	0.044	7	0.022	14	0.076	5	0.133	1
385	Professional & scientific equipment	0.009	22	0.010	20	0.002	24	0.006	24	0.005	24	0.008	21	0.014	20
390	Other manufactured products	0.009	21	0.022	15	0.005	23	0.015	19	0.007	23	0.009	19	0.021	17

Table 4 (cont'd),

		Germany	rank	Greece	rank	Hungary	rank	India	rank	Italy	rank	Japan	rank	Korea	rank
311	Food products	0.051	6	0.126	2	0.121	1	0.190	2	0.053	7	0.095	3	0.063	4
313	Beverages	0.015	18	0.029	10	0.019	15	0.006	20	0.010	22	0.009	20	0.013	19
314	Tobacco	0.003	24	0.022	16	0.004	24	0.057	6	0.006	24	0.000	24	0.007	24
321	Textiles	0.042	8	0.176	1	0.084	4	0.226	1	0.085	4	0.070	6	0.193	1
322	Wearing apparel. except footwear	0.030	10	0.094	3	0.057	6	0.007	17	0.051	8	0.042	8	0.104	3
323	Leather products	0.005	23	0.013	20	0.010	21	0.005	21	0.008	23	0.004	22	0.011	21
324	Footwear. except rubber or plastic	0.007	22	0.023	15	0.027	13	0.004	23	0.024	13	0.003	23	0.013	20
331	Wood products. except furniture	0.017	17	0.024	13	0.013	18	0.010	15	0.014	19	0.037	10	0.022	15
332	Furniture. except metal	0.023	16	0.015	19	0.022	14	0.001	24	0.022	15	0.016	18	0.008	23
341	Paper and products	0.023	14	0.023	14	0.011	20	0.019	13	0.020	16	0.027	13	0.022	14
342	Printing and publishing	0.026	12	0.026	11	0.014	17	0.023	12	0.026	12	0.047	7	0.022	16
351	Industrial chemicals	0.044	7	0.018	18	0.030	11	0.027	11	0.042	9	0.020	16	0.019	17
352	Other chemicals	0.037	9	0.038	8	0.019	15	0.044	8	0.034	11	0.020	17	0.025	13
355	Rubber products	0.014	19	0.008	21	0.008	23	0.013	14	0.019	17	0.013	19	0.050	6
356	Plastic products	0.028	11	0.030	9	0.010	21	0.006	18	0.022	14	0.033	12	0.027	11
362	Glass and products	0.010	20	0.007	23	0.013	18	0.009	16	0.011	20	0.006	21	0.009	22
369	Other non-metallic mineral products	0.024	13	0.049	6	0.029	12	0.040	9	0.036	10	0.034	11	0.027	12
371	Iron and steel	0.070	5	0.019	17	0.055	7	0.078	3	0.073	5	0.041	9	0.033	10
381	Fabricated metal products	0.071	4	0.066	5	0.042	9	0.028	10	0.061	6	0.076	5	0.045	7
382	Machinery. except electrical	0.155	1	0.025	12	0.095	3	0.061	5	0.093	3	0.111	2	0.041	8
383	Machinery. electric	0.127	2	0.047	7	0.117	2	0.045	7	0.097	2	0.139	1	0.105	2
384	Transport equipment	0.120	3	0.079	4	0.075	5	0.073	4	0.126	1	0.087	4	0.062	5
385	Professional & scientific equipment	0.023	15	0.002	24	0.042	9	0.006	19	0.019	17	0.024	14	0.014	18
390	Other manufactured products	0.008	21	0.008	22	0.055	7	0.004	22	0.010	21	0.021	15	0.038	9

Table 4 (cont'd),

		Netherlands	rank	Norway	rank	Poland	rank	Portugal	rank	Zimbabwe	rank	Spain	rank
311	Food products	0.144	1	0.140	1	0.124	2	0.111	2	0.146	1	0.112	1
313	Beverages	0.015	16	0.015	17	0.009	22	0.014	19	0.039	7	0.029	14
314	Tobacco	0.011	18	0.003	23	0.002	24	0.003	24	0.031	10	0.005	23
321	Textiles	0.034	11	0.031	10	0.105	3	0.213	1	0.118	2	0.072	4
322	Wearing apparel. except footwear	0.016	15	0.018	16	0.053	7	0.060	5	0.093	4	0.043	9
323	Leather products	0.004	22	0.003	24	0.009	23	0.007	21	0.004	23	0.009	22
324	Footwear. except rubber or plastic	0.006	21	0.003	21	0.025	12	0.027	13	0.029	12	0.024	16
331	Wood products. except furniture	0.020	13	0.063	6	0.023	13	0.059	6	0.051	6	0.035	12
332	Furniture. except metal	0.015	16	0.025	12	0.026	11	0.019	17	0.034	9	0.036	11
341	Paper and products	0.028	12	0.047	8	0.013	18	0.027	12	0.020	17	0.022	18
342	Printing and publishing	0.073	6	0.096	4	0.012	20	0.036	9	0.029	14	0.031	13
351	Industrial chemicals	0.066	7	0.028	11	0.032	10	0.022	16	0.017	18	0.022	17
352	Other chemicals	0.035	9	0.022	14	0.016	15	0.030	11	0.025	16	0.037	10
355	Rubber products	0.008	20	0.005	20	0.011	21	0.011	20	0.014	20	0.017	19
356	Plastic products	0.020	13	0.019	15	0.014	17	0.023	15	0.014	19	0.024	15
362	Glass and products	0.035	9	0.007	19	0.015	16	0.015	18	0.005	22	0.011	21
369	Other non-metallic mineral products	0.000	24	0.023	13	0.034	9	0.051	7	0.036	8	0.052	8
371	Iron and steel	0.046	8	0.038	9	0.045	8	0.025	14	0.084	5	0.057	7
381	Fabricated metal products	0.086	4	0.072	5	0.070	6	0.061	4	0.097	3	0.080	3
382	Machinery. except electrical	0.098	3	0.097	3	0.138	1	0.036	10	0.028	15	0.072	4
383	Machinery. electric	0.125	2	0.060	7	0.074	5	0.046	8	0.031	10	0.064	6
384	Transport equipment	0.084	5	0.123	2	0.094	4	0.068	3	0.029	12	0.102	2
385	Professional & scientific equipment	0.011	18	0.003	21	0.012	19	0.004	22	0.001	24	0.005	24
390	Other manufactured products	0.001	23	0.008	18	0.018	14	0.004	23	0.013	21	0.013	20

Table 4 (cont'd),

		Turkey	rank	Sweden	rank	Denmark	rank	UK	rank	USA	rank	Venezuela	rank
311	Food products	0.146	2	0.078	5	0.169	1	0.091	4	0.070	5	0.158	1
313	Beverages	0.015	16	0.006	20	0.030	11	0.017	16	0.010	20	0.039	12
314	Tobacco	0.059	6	0.002	24	0.008	21	0.006	23	0.003	24	0.010	21
321	Textiles	0.210	1	0.023	12	0.037	7	0.052	6	0.050	8	0.049	7
322	Wearing apparel. except footwear	0.017	13	0.016	14	0.028	13	0.041	9	0.058	7	0.071	3
323	Leather products	0.006	21	0.002	23	0.003	24	0.005	24	0.004	23	0.008	23
324	Footwear. except rubber or plastic	0.007	20	0.003	22	0.007	22	0.010	21	0.008	22	0.039	11
331	Wood products. except furniture	0.016	14	0.062	7	0.024	15	0.017	17	0.025	12	0.018	18
332	Furniture. except metal	0.005	23	0.015	15	0.032	10	0.019	15	0.022	16	0.031	16
341	Paper and products	0.023	12	0.072	6	0.024	16	0.031	11	0.034	10	0.032	15
342	Printing and publishing	0.013	18	0.053	9	0.066	5	0.052	6	0.067	6	0.041	10
351	Industrial chemicals	0.030	10	0.024	11	0.030	12	0.031	10	0.025	14	0.020	17
352	Other chemicals	0.026	11	0.030	10	0.033	9	0.030	12	0.024	15	0.062	4
355	Rubber products	0.013	18	0.012	18	0.007	23	0.014	19	0.012	19	0.013	19
356	Plastic products	0.015	15	0.014	16	0.021	17	0.024	13	0.025	13	0.041	9
362	Glass and products	0.014	17	0.005	21	0.008	20	0.008	22	0.009	21	0.011	20
369	Other non-metallic mineral products	0.050	7	0.022	13	0.034	8	0.023	14	0.020	18	0.045	8
371	Iron and steel	0.068	3	0.059	8	0.013	19	0.045	8	0.038	9	0.062	5
381	Fabricated metal products	0.048	8	0.091	4	0.078	3	0.069	5	0.078	4	0.071	2
382	Machinery. except electrical	0.061	5	0.138	1	0.149	2	0.127	2	0.132	1	0.034	14
383	Machinery. electric	0.039	9	0.096	3	0.065	6	0.103	3	0.105	2	0.035	13
384	Transport equipment	0.062	4	0.138	2	0.075	4	0.129	1	0.100	3	0.055	6
385	Professional & scientific equipment	0.002	24	0.012	17	0.025	14	0.016	18	0.032	11	0.004	24
390	Other manufactured products	0.005	22	0.006	19	0.016	18	0.013	20	0.021	17	0.010	21

Table 5: 1990 Employment Shares

		austria	rank	canada	rank	chile	rank	colombia	rank	denmark	rank	ecuador	rank
311	Food products	0.082	4	0.106	2	0.252	1	0.162	1	0.171	1	0.243	1
313	Beverages	0.020	17	0.013	19	0.034	10	0.048	6	0.014	18	0.066	3
314	Tobacco	0.002	24	0.003	23	0.002	23	0.004	24	0.004	22	0.007	21
321	Textiles	0.058	5	0.039	10	0.088	2	0.108	2	0.032	9	0.130	2
322	Wearing apparel. except footwear	0.038	11	0.050	9	0.058	5	0.096	3	0.023	14	0.034	11
323	Leather products	0.004	23	0.003	23	0.006	21	0.017	19	0.002	24	0.009	19
324	Footwear. except rubber or plastic	0.013	19	0.006	22	0.038	8	0.031	14	0.003	23	0.015	16
331	Wood products. except furniture	0.030	14	0.055	8	0.071	4	0.013	22	0.028	12	0.029	12
332	Furniture. except metal	0.048	8	0.035	12	0.017	16	0.018	17	0.040	7	0.028	13
341	Paper and products	0.031	13	0.061	7	0.030	11	0.024	15	0.021	16	0.036	10
342	Printing and publishing	0.038	10	0.076	4	0.029	12	0.045	7	0.108	3	0.037	9
351	Industrial chemicals	0.032	12	0.018	17	0.012	18	0.034	12	0.021	17	0.015	15
352	Other chemicals	0.029	15	0.036	11	0.055	6	0.053	5	0.035	8	0.058	5
355	Rubber products	0.011	20	0.013	18	0.010	19	0.013	21	0.006	20	0.014	17
356	Plastic products	0.021	16	0.033	13	0.036	9	0.038	10	0.025	13	0.052	6
362	Glass and products	0.014	18	0.006	21	0.007	20	0.014	20	0.005	21	0.005	23
369	Other non-metallic mineral products	0.040	9	0.022	16	0.020	15	0.042	8	0.028	11	0.042	7
371	Iron and steel	0.057	6	0.028	14	0.027	14	0.019	16	0.009	19	0.013	18
381	Fabricated metal products	0.090	3	0.072	5	0.071	3	0.058	4	0.089	4	0.060	4
382	Machinery. except electrical	0.114	2	0.079	3	0.042	7	0.032	13	0.158	2	0.006	22
383	Machinery. electric	0.129	1	0.066	6	0.013	17	0.037	11	0.062	5	0.037	8
384	Transport equipment	0.049	7	0.109	1	0.029	13	0.039	9	0.051	6	0.019	14
385	Professional & scientific equipment	0.011	22	0.009	20	0.002	24	0.008	23	0.030	10	0.005	24
390	Other manufactured products	0.011	20	0.026	15	0.005	22	0.018	17	0.022	15	0.007	20

Table 5 (cont'd),

		finland	rank	france	rank	germany	rank	greece	rank	hungary	rank	india	rank
311	Food products	0.108	2	0.106	3	0.053	5	0.143	2	0.151	1	0.152	2
313	Beverages	0.013	18	0.010	22	0.012	19	0.030	9	0.022	16	0.008	18
314	Tobacco	0.003	24	0.001	24	0.002	24	0.027	12	0.004	24	0.060	6
321	Textiles	0.025	13	0.048	7	0.032	10	0.145	1	0.068	4	0.193	1
322	Wearing apparel. except footwear	0.034	10	0.033	10	0.020	14	0.115	3	0.056	6	0.015	15
323	Leather products	0.003	23	0.005	23	0.003	23	0.010	20	0.009	22	0.006	22
324	Footwear. except rubber or plastic	0.007	20	0.012	21	0.004	22	0.019	16	0.025	12	0.007	20
331	Wood products. except furniture	0.070	6	0.021	16	0.015	17	0.021	15	0.013	19	0.008	17
332	Furniture. except metal	0.025	13	0.019	18	0.020	15	0.018	18	0.023	14	0.001	24
341	Paper and products	0.103	3	0.025	13	0.023	12	0.026	13	0.012	21	0.020	13
342	Printing and publishing	0.088	4	0.054	6	0.025	11	0.029	10	0.019	17	0.020	12
351	Industrial chemicals	0.032	11	0.027	12	0.043	6	0.018	17	0.033	10	0.031	11
352	Other chemicals	0.024	15	0.042	9	0.040	7	0.046	7	0.023	14	0.045	9
355	Rubber products	0.006	22	0.022	15	0.014	18	0.007	22	0.007	23	0.015	14
356	Plastic products	0.018	16	0.028	11	0.040	8	0.028	11	0.016	18	0.011	16
362	Glass and products	0.007	20	0.013	20	0.010	20	0.005	23	0.013	19	0.007	19
369	Other non-metallic mineral products	0.036	9	0.020	17	0.020	16	0.054	6	0.025	12	0.049	8
371	Iron and steel	0.030	12	0.043	8	0.036	9	0.016	19	0.039	8	0.065	5
381	Fabricated metal products	0.074	5	0.081	5	0.093	4	0.059	5	0.045	7	0.031	10
382	Machinery. except electrical	0.121	1	0.101	4	0.165	1	0.025	14	0.122	2	0.065	4
383	Machinery. electric	0.066	7	0.109	2	0.145	2	0.040	8	0.107	3	0.054	7
384	Transport equipment	0.064	8	0.123	1	0.134	3	0.065	4	0.060	5	0.089	3
385	Professional & scientific equipment	0.013	17	0.016	19	0.020	13	0.002	24	0.039	8	0.007	21
390	Other manufactured products	0.008	19	0.023	14	0.008	21	0.007	21	0.032	11	0.006	23

Table 5 (cont'd),

		italy	rank	japan	rank	korea	rank	netherlands	rank	norway	rank	poland	rank	portugal	rank
311	Food products	0.059	6	0.102	3	0.060	7	0.138	2	0.162	1	0.121	2	0.098	3
313	Beverages	0.009	23	0.007	20	0.008	23	0.014	15	0.016	16	0.010	22	0.018	15
314	Tobacco	0.006	24	0.001	24	0.002	24	0.008	19	0.002	22	0.003	24	0.002	24
321	Textiles	0.081	4	0.057	6	0.118	2	0.027	12	0.021	13	0.095	3	0.156	1
322	Wearing apparel. except footwear	0.055	7	0.044	8	0.078	4	0.010	17	0.008	18	0.053	7	0.143	2
323	Leather products	0.010	22	0.004	22	0.014	20	0.002	24	0.002	23	0.009	23	0.010	21
324	Footwear. except rubber or plastic	0.027	12	0.003	23	0.010	21	0.003	23	0.002	24	0.028	11	0.058	5
331	Wood products. except furniture	0.013	18	0.027	12	0.014	19	0.016	14	0.056	7	0.022	13	0.054	6
332	Furniture. except metal	0.025	13	0.015	18	0.014	18	0.013	16	0.025	11	0.026	12	0.037	10
341	Paper and products	0.022	15	0.023	13	0.020	15	0.031	11	0.044	8	0.014	17	0.018	14
342	Printing and publishing	0.030	11	0.052	7	0.024	14	0.078	5	0.120	3	0.013	19	0.033	12
351	Industrial chemicals	0.031	10	0.016	17	0.018	16	0.074	6	0.031	9	0.036	9	0.012	19
352	Other chemicals	0.018	16	0.020	14	0.026	13	0.041	9	0.020	15	0.018	15	0.023	13
355	Rubber products	0.017	17	0.014	19	0.062	6	0.007	21	0.004	21	0.011	21	0.007	22
356	Plastic products	0.033	9	0.041	9	0.034	9	0.033	10	0.021	14	0.014	18	0.017	16
362	Glass and products	0.011	21	0.006	21	0.009	22	0.008	20	0.005	20	0.015	16	0.010	20
369	Other non-metallic mineral products	0.023	14	0.028	11	0.028	12	0.021	13	0.022	12	0.034	10	0.037	11
371	Iron and steel	0.052	8	0.030	10	0.030	11	0.043	8	0.027	10	0.045	8	0.015	17
381	Fabricated metal products	0.061	5	0.080	5	0.059	8	0.083	4	0.078	5	0.065	6	0.078	4
382	Machinery. except electrical	0.138	1	0.126	2	0.071	5	0.101	3	0.122	2	0.138	1	0.040	8
383	Machinery. electric	0.097	3	0.163	1	0.152	1	0.144	1	0.060	6	0.078	5	0.040	7
384	Transport equipment	0.116	2	0.083	4	0.082	3	0.073	7	0.088	4	0.092	4	0.039	9
385	Professional & scientific equipment	0.012	20	0.019	16	0.015	17	0.009	18	0.006	19	0.012	20	0.004	23
390	Other manufactured products	0.013	19	0.020	15	0.031	10	0.003	22	0.009	17	0.021	14	0.015	18

Table 5 (cont'd),

		zimbabwe	rank	spain	rank	sweden	rank	turkey	rank	uk	rank	usa	rank	venezuela	rank
311	Food products	0.137	1	0.136	1	0.086	4	0.133	2	0.105	4	0.076	5	0.177	1
313	Beverages	0.036	7	0.028	15	0.007	19	0.014	16	0.014	19	0.008	21	0.034	13
314	Tobacco	0.029	14	0.005	24	0.002	22	0.033	10	0.003	24	0.002	24	0.007	23
321	Textiles	0.126	2	0.057	5	0.018	14	0.203	1	0.047	7	0.047	8	0.054	6
322	Wearing apparel. except footwear	0.113	3	0.045	8	0.009	18	0.076	3	0.044	8	0.046	9	0.061	3
323	Leather products	0.007	22	0.009	22	0.002	22	0.005	21	0.004	23	0.003	23	0.009	22
324	Footwear. except rubber or plastic	0.033	9	0.016	19	0.001	24	0.006	20	0.009	21	0.004	22	0.035	12
331	Wood products. except furniture	0.030	13	0.039	12	0.061	7	0.014	17	0.016	17	0.029	12	0.015	18
332	Furniture. except metal	0.027	15	0.030	14	0.015	16	0.004	24	0.024	15	0.025	14	0.026	17
341	Paper and products	0.025	16	0.022	16	0.072	6	0.022	13	0.031	12	0.034	11	0.029	15
342	Printing and publishing	0.032	10	0.044	9	0.058	8	0.014	18	0.063	6	0.088	4	0.040	9
351	Industrial chemicals	0.016	19	0.022	17	0.025	11	0.032	11	0.030	13	0.023	16	0.026	16
352	Other chemicals	0.031	12	0.043	10	0.033	10	0.028	12	0.035	9	0.028	13	0.061	4
355	Rubber products	0.016	20	0.017	18	0.010	17	0.013	19	0.014	20	0.012	19	0.013	21
356	Plastic products	0.017	18	0.034	13	0.018	14	0.016	14	0.035	10	0.038	10	0.046	7
362	Glass and products	0.005	23	0.011	21	0.006	20	0.015	15	0.009	22	0.008	20	0.013	19
369	Other non-metallic mineral products	0.032	11	0.048	7	0.022	13	0.047	8	0.026	14	0.021	18	0.045	8
371	Iron and steel	0.087	4	0.040	11	0.042	9	0.064	5	0.031	11	0.024	15	0.058	5
381	Fabricated metal products	0.086	5	0.076	3	0.101	3	0.041	9	0.070	5	0.074	6	0.074	2
382	Machinery. except electrical	0.019	17	0.073	4	0.139	2	0.053	6	0.116	1	0.118	1	0.031	14
383	Machinery. electric	0.035	8	0.057	6	0.076	5	0.047	7	0.106	3	0.088	3	0.036	10
384	Transport equipment	0.038	6	0.106	2	0.150	1	0.065	4	0.111	2	0.109	2	0.036	10
385	Professional & scientific equipment	0.001	24	0.005	23	0.023	12	0.005	23	0.018	16	0.052	7	0.006	24
390	Other manufactured products	0.010	21	0.012	20	0.004	21	0.005	22	0.015	18	0.021	17	0.013	20

Table 6: 2000 Employment Shares

		austria	rank	canada	rank	chile	rank	colombia	rank	ecuador	rank	finland	rank
311	Food products	0.098	4	0.117	2	0.283	1	0.206	1	0.352	1	0.090	5
313	Beverages	0.000	21	0.014	19	0.045	6	0.039	9	0.047	4	0.000	21
314	Tobacco	0.000	21	0.001	24	0.002	24	0.002	23	0.004	22	0.000	21
321	Textiles	0.026	14	0.033	12	0.043	7	0.088	3	0.090	2	0.015	15
322	Wearing apparel. except footwear	0.000	21	0.042	9	0.032	10	0.135	2	0.039	7	0.015	14
323	Leather products	0.004	20	0.003	23	0.005	21	0.012	19	0.006	21	0.002	20
324	Footwear. except rubber or plastic	0.006	19	0.004	22	0.022	15	0.021	15	0.024	14	0.005	19
331	Wood products. except furniture	0.057	6	0.068	5	0.070	3	0.009	21	0.032	10	0.071	7
332	Furniture. except metal	0.058	5	0.056	7	0.020	16	0.023	14	0.029	12	0.029	10
341	Paper and products	0.029	13	0.050	8	0.038	8	0.039	8	0.042	6	0.101	3
342	Printing and publishing	0.039	9	0.040	10	0.030	11	0.047	6	0.037	8	0.075	6
351	Industrial chemicals	0.000	21	0.014	18	0.028	13	0.018	18	0.008	20	0.022	12
352	Other chemicals	0.029	12	0.028	13	0.063	4	0.069	4	0.043	5	0.021	13
355	Rubber products	0.007	18	0.012	20	0.010	19	0.008	22	0.009	19	0.007	18
356	Plastic products	0.041	8	0.040	11	0.058	5	0.052	5	0.048	3	0.037	9
362	Glass and products	0.016	17	0.006	21	0.008	20	0.009	20	0.004	23	0.012	16
369	Other non-metallic mineral products	0.032	11	0.020	16	0.024	14	0.040	7	0.035	9	0.000	21
371	Iron and steel	0.036	10	0.026	14	0.018	17	0.019	17	0.013	16	0.000	21
381	Fabricated metal products	0.103	2	0.087	4	0.074	2	0.038	10	0.032	11	0.091	4
382	Machinery. except electrical	0.123	1	0.089	3	0.036	9	0.037	11	0.029	13	0.147	1
383	Machinery. electric	0.100	3	0.064	6	0.014	18	0.029	12	0.010	18	0.138	2
384	Transport equipment	0.056	7	0.120	1	0.030	12	0.026	13	0.020	15	0.048	8
385	Professional & scientific equipment	0.022	15	0.021	15	0.002	23	0.000	24	0.001	24	0.028	11
390	Other manufactured products	0.018	16	0.017	17	0.003	22	0.021	16	0.011	17	0.009	17

Table 6 (cont'd),

		france	rank	hungary	rank	india	rank	italy	rank	japan	rank	korea	rank	norway	rank
311	Food products	0.140	1	0.142	2	0.161	2	0.072	3	0.126	3	0.060	6	0.164	1
313	Beverages	0.012	21	0.019	16	0.011	19	0.008	23	0.008	20	0.007	23	0.020	16
314	Tobacco	0.000	24	0.003	24	0.062	4	0.002	24	0.001	24	0.001	24	0.000	24
321	Textiles	0.031	10	0.044	7	0.166	1	0.065	6	0.038	8	0.087	4	0.017	17
322	Wearing apparel. except footwear	0.026	12	0.090	4	0.042	10	0.060	7	0.024	13	0.054	7	0.005	20
323	Leather products	0.005	23	0.006	23	0.007	21	0.014	20	0.003	23	0.008	21	0.001	22
324	Footwear. except rubber or plastic	0.007	22	0.024	12	0.011	18	0.029	13	0.004	22	0.012	19	0.001	23
331	Wood products. except furniture	0.023	14	0.030	10	0.006	23	0.028	14	0.022	15	0.010	20	0.051	7
332	Furniture. except metal	0.027	11	0.024	13	0.003	24	0.038	8	0.013	18	0.015	17	0.036	8
341	Paper and products	0.024	13	0.013	19	0.023	13	0.019	17	0.026	11	0.021	14	0.031	9
342	Printing and publishing	0.053	6	0.031	9	0.015	15	0.034	12	0.055	6	0.032	9	0.121	3
351	Industrial chemicals	0.021	15	0.019	15	0.040	11	0.016	19	0.017	17	0.024	12	0.027	10
352	Other chemicals	0.052	7	0.028	11	0.063	3	0.034	11	0.024	12	0.029	11	0.020	15
355	Rubber products	0.018	18	0.010	21	0.014	16	0.012	21	0.013	19	0.014	18	0.002	21
356	Plastic products	0.042	8	0.032	8	0.019	14	0.036	10	0.047	7	0.046	8	0.021	13
362	Glass and products	0.013	19	0.010	22	0.007	22	0.009	22	0.006	21	0.007	22	0.007	19
369	Other non-metallic mineral products	0.021	17	0.022	14	0.047	8	0.037	9	0.027	10	0.022	13	0.024	11
371	Iron and steel	0.021	16	0.017	18	0.061	5	0.023	16	0.023	14	0.030	10	0.021	14
381	Fabricated metal products	0.114	2	0.072	5	0.038	12	0.133	1	0.088	5	0.068	5	0.072	5
382	Machinery. except electrical	0.093	4	0.091	3	0.058	6	0.133	2	0.138	2	0.125	2	0.086	4
383	Machinery. electric	0.087	5	0.151	1	0.044	9	0.071	4	0.143	1	0.162	1	0.053	6
384	Transport equipment	0.103	3	0.054	6	0.057	7	0.065	5	0.090	4	0.115	3	0.142	2
385	Professional & scientific equipment	0.036	9	0.018	17	0.008	20	0.024	15	0.028	9	0.018	15	0.022	12
390	Other manufactured products	0.013	20	0.011	20	0.011	17	0.017	18	0.019	16	0.017	16	0.010	18

Table 6 (cont'd),

		poland	rank	portugal	rank	spain	rank	sweden	rank	turkey	rank	uk	rank	usa	rank
311	Food products	0.163	1	0.098	3	0.124	1	0.077	5	0.127	2	0.093	2	0.087	5
313	Beverages	0.018	16	0.015	16	0.018	17	0.006	18	0.010	19	0.010	19	0.008	19
314	Tobacco	0.004	24	0.001	24	0.003	24	0.001	23	0.017	14	0.001	24	0.002	23
321	Textiles	0.041	9	0.107	2	0.044	10	0.011	16	0.000	24	0.033	10	0.037	9
322	Wearing apparel. except footwear	0.080	3	0.146	1	0.051	8	0.002	21	0.130	1	0.028	12	0.026	13
323	Leather products	0.005	23	0.007	21	0.008	23	0.001	22	0.007	21	0.002	23	0.002	21
324	Footwear. except rubber or plastic	0.015	20	0.066	5	0.021	16	0.001	24	0.008	20	0.003	22	0.002	22
331	Wood products. except furniture	0.049	8	0.056	7	0.039	11	0.048	8	0.010	18	0.018	16	0.030	12
332	Furniture. except metal	0.053	7	0.059	6	0.051	7	0.015	14	0.021	11	0.034	9	0.039	8
341	Paper and products	0.016	18	0.015	15	0.023	14	0.063	6	0.020	12	0.022	13	0.031	11
342	Printing and publishing	0.030	13	0.040	12	0.055	5	0.063	7	0.011	17	0.078	5	0.000	24
351	Industrial chemicals	0.017	17	0.007	22	0.017	18	0.025	12	0.020	13	0.021	14	0.021	16
352	Other chemicals	0.021	14	0.018	14	0.038	12	0.035	10	0.032	9	0.038	8	0.031	10
355	Rubber products	0.010	22	0.005	23	0.013	19	0.007	17	0.013	15	0.009	20	0.012	18
356	Plastic products	0.035	12	0.020	13	0.035	13	0.015	13	0.025	10	0.046	7	0.053	6
362	Glass and products	0.019	15	0.010	18	0.010	22	0.005	19	0.012	16	0.008	21	0.007	20
369	Other non-metallic mineral produc	0.038	10	0.043	10	0.055	6	0.014	15	0.044	7	0.019	15	0.022	15
371	Iron and steel	0.036	11	0.008	19	0.021	15	0.034	11	0.043	8	0.016	17	0.019	17
381	Fabricated metal products	0.074	5	0.087	4	0.121	2	0.103	4	0.046	5	0.087	4	0.103	1
382	Machinery. except electrical	0.095	2	0.050	9	0.075	4	0.105	3	0.065	3	0.095	1	0.100	2
383	Machinery. electric	0.053	6	0.050	8	0.050	9	0.157	1	0.045	6	0.075	6	0.091	4
384	Transport equipment	0.076	4	0.043	11	0.088	3	0.152	2	0.055	4	0.092	3	0.098	3
385	Professional & scientific equipme	0.015	19	0.007	20	0.011	21	0.037	9	0.003	23	0.032	11	0.047	7
390	Other manufactured products	0.013	21	0.012	17	0.012	20	0.004	20	0.006	22	0.015	18	0.023	14

Table 7: 1981 Export Shares

ISIC	austria	rank	canada	rank	chile	rank	colombia	rank	denmark	rank	ecuador	rank	finland	rank	france	rank
311	0.029	10	0.051	6	0.298	1	0.591	1	0.322	1	0.753	1	0.037	10	0.087	4
313	0.006	22	0.010	12	0.040	6	0.001	24	0.008	17	0.003	15	0.003	22	0.036	10
314	0.000	24	0.000	24	0.000	24	0.001	23	0.003	23	0.003	14	0.005	20	0.001	24
321	0.102	3	0.007	14	0.006	13	0.062	2	0.036	9	0.014	6	0.020	12	0.046	8
322	0.024	12	0.005	18	0.000	23	0.059	3	0.018	14	0.020	5	0.052	5	0.018	13
323	0.005	23	0.001	23	0.002	17	0.016	11	0.003	24	0.000	20	0.001	24	0.005	23
324	0.019	16	0.001	22	0.001	20	0.008	16	0.005	20	0.000	23	0.015	13	0.006	22
331	0.058	7	0.069	4	0.108	3	0.007	17	0.025	11	0.092	2	0.114	2	0.007	20
332	0.009	20	0.006	17	0.000	22	0.002	21	0.029	10	0.000	16	0.010	15	0.006	21
341	0.063	6	0.186	2	0.270	2	0.025	8	0.013	15	0.006	10	0.308	1	0.018	14
342	0.009	20	0.005	19	0.006	12	0.028	6	0.008	19	0.000	18	0.009	18	0.009	17
351	0.086	5	0.064	5	0.095	4	0.035	4	0.044	5	0.011	7	0.049	6	0.103	3
352	0.023	13	0.006	16	0.005	14	0.016	12	0.042	6	0.009	8	0.021	11	0.047	7
355	0.017	17	0.010	11	0.012	10	0.002	22	0.005	22	0.000	21	0.003	23	0.021	12
356	0.013	18	0.002	21	0.001	19	0.009	15	0.019	13	0.006	11	0.011	14	0.008	19
362	0.012	19	0.002	20	0.002	16	0.009	14	0.005	21	0.000	23	0.007	19	0.013	16
369	0.027	11	0.006	15	0.000	21	0.025	7	0.010	16	0.006	9	0.004	21	0.009	18
371	0.104	2	0.050	7	0.016	8	0.004	20	0.021	12	0.000	19	0.041	8	0.080	5
381	0.057	8	0.023	9	0.020	7	0.033	5	0.041	7	0.004	12	0.038	9	0.041	9
382	0.146	1	0.129	3	0.014	9	0.022	9	0.161	2	0.049	3	0.102	3	0.136	2
383	0.093	4	0.038	8	0.009	11	0.013	13	0.058	4	0.021	4	0.046	7	0.073	6
384	0.055	9	0.312	1	0.090	5	0.019	10	0.079	3	0.000	22	0.086	4	0.189	1
385	0.022	14	0.010	10	0.003	15	0.006	18	0.037	8	0.000	17	0.009	16	0.025	11
390	0.022	15	0.008	13	0.002	18	0.006	19	0.008	18	0.003	13	0.009	17	0.015	15

Table 7 (cont'd),

ISIC	germany	rank	greece	rank	india	rank	italy	rank	japan	rank	korea	rank	netherlands	rank	norway	rank
311	0.049	6	0.183	2	0.232	1	0.040	10	0.008	12	0.032	10	0.264	1	0.152	2
313	0.005	21	0.014	14	0.000	23	0.015	17	0.001	22	0.001	20	0.014	13	0.001	22
314	0.002	24	0.000	24	0.009	14	0.000	24	0.000	24	0.000	22	0.016	12	0.001	23
321	0.042	8	0.219	1	0.210	2	0.084	3	0.041	7	0.193	1	0.053	5	0.021	9
322	0.013	12	0.097	4	0.000	24	0.042	9	0.003	16	0.000	23	0.017	11	0.007	14
323	0.003	23	0.005	18	0.091	3	0.014	18	0.002	18	0.001	21	0.004	22	0.003	18
324	0.003	22	0.034	9	0.025	10	0.044	8	0.000	23	0.000	23	0.003	23	0.001	21
331	0.005	20	0.005	17	0.005	16	0.007	23	0.001	21	0.033	9	0.007	20	0.016	11
332	0.010	17	0.001	23	0.001	22	0.026	13	0.001	20	0.003	19	0.008	19	0.011	12
341	0.018	11	0.018	13	0.001	21	0.011	20	0.006	14	0.008	15	0.030	10	0.137	3
342	0.009	18	0.004	19	0.005	17	0.008	22	0.002	19	0.004	17	0.012	15	0.003	19
351	0.119	3	0.063	6	0.028	9	0.064	4	0.045	6	0.044	6	0.215	2	0.058	6
352	0.032	10	0.020	12	0.080	5	0.021	14	0.012	11	0.005	16	0.032	9	0.019	10
355	0.011	14	0.003	20	0.011	12	0.013	19	0.014	10	0.035	8	0.010	17	0.006	15
356	0.010	16	0.008	15	0.003	19	0.018	15	0.004	15	0.020	14	0.013	14	0.010	13
362	0.007	19	0.003	21	0.006	15	0.009	21	0.003	17	0.004	18	0.005	21	0.003	20
369	0.011	15	0.098	3	0.009	13	0.032	12	0.008	13	0.030	11	0.010	18	0.006	16
371	0.072	4	0.088	5	0.022	11	0.064	5	0.116	4	0.136	3	0.061	4	0.109	5
381	0.047	7	0.041	7	0.072	6	0.062	6	0.031	8	0.065	5	0.044	7	0.037	8
382	0.203	2	0.027	10	0.059	7	0.195	1	0.147	3	0.030	12	0.052	6	0.135	4
383	0.070	5	0.038	8	0.039	8	0.058	7	0.188	2	0.158	2	0.037	8	0.058	7
384	0.211	1	0.022	11	0.085	4	0.116	2	0.293	1	0.129	4	0.083	3	0.202	1
385	0.036	9	0.002	22	0.002	20	0.015	16	0.056	5	0.026	13	0.000	24	0.000	24
390	0.012	13	0.006	16	0.004	18	0.040	11	0.017	9	0.043	7	0.011	16	0.005	17

Table 7 (cont'd),

ISIC	portugal	rank	spain	rank	sweden	rank	turkey	rank	uk	rank	usa	rank	venezuela	rank
311	0.070	6	0.084	4	0.019	10	0.174	2	0.039	9	0.063	5	0.018	8
313	0.003	22	0.025	14	0.001	23	0.004	19	0.028	12	0.002	23	0.001	20
314	0.001	24	0.001	24	0.001	22	0.000	24	0.010	17	0.007	16	0.000	24
321	0.194	1	0.050	7	0.018	11	0.280	1	0.044	7	0.025	10	0.004	15
322	0.131	2	0.013	18	0.007	15	0.131	3	0.018	13	0.005	20	0.000	22
323	0.001	23	0.009	19	0.003	20	0.001	21	0.006	20	0.003	22	0.000	23
324	0.044	9	0.037	10	0.002	21	0.001	23	0.003	23	0.001	24	0.001	19
331	0.111	3	0.014	17	0.057	6	0.011	14	0.003	24	0.011	13	0.005	13
332	0.003	21	0.009	20	0.016	12	0.005	18	0.005	22	0.003	21	0.000	21
341	0.086	4	0.025	13	0.174	3	0.007	17	0.012	16	0.029	9	0.027	6
342	0.007	17	0.024	15	0.006	17	0.001	20	0.013	15	0.009	14	0.010	10
351	0.056	7	0.072	5	0.047	7	0.041	6	0.101	3	0.102	3	0.260	2
352	0.021	13	0.025	12	0.022	9	0.014	13	0.053	5	0.034	7	0.024	7
355	0.003	20	0.027	11	0.008	14	0.010	15	0.014	14	0.008	15	0.003	17
356	0.005	19	0.008	21	0.008	13	0.018	11	0.008	18	0.005	19	0.005	12
362	0.014	16	0.008	22	0.006	16	0.035	7	0.006	21	0.005	17	0.004	14
369	0.016	15	0.051	6	0.004	19	0.101	4	0.008	19	0.005	18	0.002	18
371	0.017	14	0.118	3	0.077	5	0.034	8	0.038	10	0.019	11	0.387	1
381	0.028	12	0.049	8	0.035	8	0.025	10	0.043	8	0.033	8	0.032	5
382	0.035	10	0.119	2	0.187	2	0.028	9	0.201	1	0.244	1	0.055	4
383	0.075	5	0.042	9	0.093	4	0.015	12	0.084	4	0.099	4	0.010	9
384	0.046	8	0.167	1	0.204	1	0.057	5	0.179	2	0.224	2	0.137	3
385	0.005	18	0.008	23	0.000	24	0.001	22	0.047	6	0.048	6	0.004	16
390	0.029	11	0.015	16	0.005	18	0.008	16	0.035	11	0.016	12	0.008	11

Table 8: 1990 Export Shares

ISIC	austria	rank	canada	rank	chile	rank	colombia	rank	denmark	rank	ecuador	rank	finland	rank	france	rank
311	0.030	10	0.035	7	0.295	1	0.418	1	0.293	1	0.712	1	0.018	9	0.066	5
313	0.006	21	0.008	15	0.037	5	0.002	23	0.012	16	0.012	10	0.002	22	0.041	9
314	0.001	23	0.000	24	0.000	24	0.001	24	0.005	18	0.008	11	0.001	24	0.001	24
321	0.024	13	0.009	14	0.023	7	0.065	5	0.029	10	0.016	6	0.012	13	0.043	8
322	0.028	11	0.003	21	0.016	10	0.162	2	0.000	23	0.040	3	0.017	10	0.020	13
323	0.008	20	0.001	22	0.001	22	0.014	10	0.002	22	0.000	21	0.001	23	0.007	22
324	0.013	19	0.001	23	0.016	11	0.028	7	0.006	17	0.000	24	0.004	19	0.004	23
331	0.065	8	0.065	5	0.146	3	0.003	21	0.021	12	0.086	2	0.083	5	0.007	21
332	0.016	17	0.013	10	0.007	16	0.002	22	0.048	8	0.002	17	0.007	16	0.008	20
341	0.093	5	0.153	2	0.208	2	0.010	15	0.018	13	0.001	18	0.325	1	0.023	12
342	0.013	18	0.005	19	0.011	14	0.038	6	0.017	14	0.001	20	0.011	14	0.010	18
351	0.096	4	0.054	6	0.118	4	0.077	3	0.050	7	0.025	5	0.042	7	0.099	3
352	0.036	9	0.010	12	0.017	9	0.011	13	0.067	4	0.012	8	0.014	12	0.057	6
355	0.020	15	0.011	11	0.013	12	0.007	16	0.003	21	0.000	23	0.004	20	0.017	14
356	0.024	14	0.007	17	0.004	18	0.005	19	0.032	9	0.008	12	0.009	15	0.013	16
362	0.019	16	0.004	20	0.001	21	0.006	17	0.005	19	0.007	13	0.005	18	0.012	17
369	0.027	12	0.006	18	0.003	19	0.019	9	0.016	15	0.001	19	0.003	21	0.009	19
371	0.102	3	0.026	8	0.036	6	0.068	4	0.024	11	0.005	15	0.055	6	0.053	7
381	0.077	6	0.022	9	0.013	13	0.021	8	0.062	6	0.027	4	0.026	8	0.034	10
382	0.118	1	0.097	3	0.009	15	0.010	14	0.142	2	0.007	14	0.161	2	0.131	2
383	0.075	7	0.069	4	0.006	17	0.012	11	0.082	3	0.015	7	0.092	3	0.088	4
384	0.106	2	0.383	1	0.018	8	0.005	18	0.062	5	0.005	16	0.088	4	0.212	1
385	0.001	22	0.009	13	0.001	23	0.003	20	0.000	23	0.000	22	0.014	11	0.029	11
390	0.000	24	0.007	16	0.002	20	0.012	12	0.004	20	0.012	9	0.007	17	0.014	15

Table 8 (cont'd),

ISIC	germany	rank	greece	rank	india	rank	italy	rank	japan	rank	korea	rank	netherlands	rank	norway	rank
311	0.036	9	0.270	1	0.103	2	0.035	10	0.003	16	0.014	13	0.245	2	0.097	5
313	0.004	21	0.026	9	0.001	22	0.012	20	0.000	23	0.001	22	0.019	11	0.001	22
314	0.003	24	0.006	20	0.005	15	0.000	24	0.000	22	0.000	23	0.032	8	0.001	21
321	0.042	7	0.206	2	0.245	1	0.085	3	0.022	7	0.135	2	0.021	9	0.018	11
322	0.017	11	0.000	24	0.000	24	0.052	6	0.002	19	0.117	4	0.000	19	0.004	19
323	0.003	23	0.018	12	0.060	8	0.021	14	0.001	20	0.006	16	0.000	18	0.003	20
324	0.003	22	0.014	13	0.068	7	0.040	8	0.000	24	0.000	24	0.000	19	0.001	23
331	0.006	20	0.009	16	0.002	20	0.006	23	0.001	21	0.003	19	0.013	16	0.043	9
332	0.011	13	0.001	23	0.000	23	0.029	13	0.002	18	0.004	18	0.015	14	0.016	12
341	0.025	10	0.010	14	0.002	21	0.014	18	0.006	12	0.008	14	0.015	13	0.145	2
342	0.010	16	0.007	19	0.003	18	0.007	22	0.003	17	0.003	21	0.020	10	0.004	17
351	0.108	3	0.063	5	0.099	4	0.050	7	0.052	5	0.050	7	0.266	1	0.060	7
352	0.037	8	0.031	7	0.100	3	0.020	16	0.018	9	0.006	17	0.072	4	0.023	10
355	0.011	14	0.007	17	0.018	12	0.012	19	0.013	11	0.020	10	0.000	19	0.009	15
356	0.016	12	0.009	15	0.004	17	0.021	15	0.004	15	0.018	11	0.034	7	0.013	13
362	0.008	19	0.003	22	0.003	19	0.009	21	0.004	14	0.003	20	0.010	17	0.006	16
369	0.009	17	0.073	4	0.009	13	0.030	12	0.005	13	0.008	15	0.014	15	0.010	14
371	0.046	5	0.127	3	0.040	10	0.040	9	0.044	6	0.076	5	0.000	19	0.105	4
381	0.046	6	0.029	8	0.047	9	0.054	5	0.019	8	0.034	8	0.064	6	0.044	8
382	0.218	2	0.023	10	0.073	5	0.226	1	0.223	3	0.052	6	0.067	5	0.117	3
383	0.080	4	0.034	6	0.039	11	0.063	4	0.231	2	0.274	1	0.075	3	0.074	6
384	0.241	1	0.022	11	0.068	6	0.122	2	0.270	1	0.121	3	0.017	12	0.201	1
385	0.010	15	0.004	21	0.006	14	0.018	17	0.060	4	0.017	12	0.000	19	0.000	24
390	0.009	18	0.007	18	0.005	16	0.033	11	0.017	10	0.031	9	0.000	19	0.004	18

Table 8 (cont'd),

ISIC	portugal	rank	zimbabwe	rank	spain	rank	sweden	rank	turkey	rank	uk	rank	usa	rank	venezuela	rank
311	0.033	10	0.274	2	0.071	4	0.019	11	0.079	4	0.033	8	0.033	8	0.085	3
313	0.034	9	0.008	13	0.018	14	0.001	21	0.002	22	0.029	10	0.029	10	0.004	21
314	0.000	24	0.012	10	0.000	24	0.001	22	0.002	21	0.008	18	0.008	18	0.019	13
321	0.141	2	0.048	5	0.039	8	0.015	13	0.244	2	0.044	6	0.044	6	0.021	12
322	0.173	1	0.053	3	0.010	19	0.006	17	0.247	1	0.016	13	0.016	13	0.029	10
323	0.003	22	0.008	12	0.008	22	0.002	20	0.004	16	0.004	22	0.004	22	0.002	23
324	0.094	3	0.001	24	0.034	9	0.000	23	0.003	18	0.003	23	0.003	23	0.000	24
331	0.070	6	0.003	19	0.009	20	0.055	7	0.004	17	0.003	24	0.003	24	0.003	22
332	0.009	18	0.003	20	0.011	16	0.017	12	0.002	23	0.006	20	0.006	20	0.005	19
341	0.068	7	0.006	15	0.027	12	0.181	2	0.006	15	0.021	11	0.021	11	0.028	11
342	0.004	21	0.002	23	0.010	17	0.007	15	0.001	24	0.018	12	0.018	12	0.015	15
351	0.050	8	0.050	4	0.079	3	0.053	8	0.064	5	0.113	3	0.113	3	0.161	2
352	0.012	15	0.010	11	0.028	11	0.040	9	0.020	10	0.062	5	0.062	5	0.032	9
355	0.006	20	0.004	17	0.024	13	0.005	18	0.008	14	0.012	15	0.012	15	0.005	18
356	0.007	19	0.002	21	0.010	18	0.013	14	0.003	20	0.014	14	0.014	14	0.019	14
362	0.010	16	0.004	18	0.008	23	0.006	16	0.021	8	0.006	21	0.006	21	0.007	16
369	0.020	13	0.013	9	0.030	10	0.004	19	0.016	11	0.007	19	0.007	19	0.047	6
371	0.013	14	0.401	1	0.067	5	0.079	5	0.155	3	0.043	7	0.043	7	0.303	1
381	0.027	12	0.015	8	0.043	7	0.057	6	0.014	12	0.033	9	0.033	9	0.057	5
382	0.030	11	0.023	7	0.095	2	0.118	3	0.021	9	0.239	1	0.239	1	0.061	4
383	0.092	4	0.005	16	0.061	6	0.090	4	0.047	6	0.112	4	0.112	4	0.044	7
384	0.090	5	0.047	6	0.296	1	0.200	1	0.025	7	0.152	2	0.152	2	0.042	8
385	0.000	23	0.002	22	0.009	21	0.030	10	0.003	19	0.011	16	0.011	16	0.004	20
390	0.010	17	0.007	14	0.012	15	0.000	23	0.009	13	0.011	17	0.011	17	0.006	17

Table 9: 2000 Export Shares

ISIC	austria	rank	canada	rank	chile	rank	colombia	rank	denmark	rank	ecuador	rank	finland	rank	france	rank
311	0.033	11	0.034	7	0.161	2	0.213	1	0.172	1	0.499	1	0.013	10	0.051	6
313	0.012	18	0.005	20	0.100	5	0.004	23	0.011	16	0.001	23	0.002	21	0.031	9
314	0.002	24	0.000	24	0.002	23	0.003	24	0.003	23	0.002	22	0.000	24	0.001	24
321	0.035	10	0.014	13	0.022	9	0.070	5	0.038	10	0.056	4	0.009	13	0.032	8
322	0.013	17	0.007	18	0.004	18	0.075	4	0.030	11	0.016	13	0.004	19	0.015	13
323	0.006	23	0.001	23	0.004	17	0.025	15	0.002	24	0.003	21	0.001	22	0.007	20
324	0.008	20	0.001	22	0.001	24	0.006	22	0.007	21	0.003	20	0.001	23	0.003	23
331	0.041	8	0.065	5	0.125	4	0.006	21	0.019	13	0.063	3	0.059	5	0.007	21
332	0.017	14	0.022	9	0.007	16	0.007	19	0.040	9	0.005	18	0.008	15	0.008	18
341	0.059	4	0.094	4	0.238	1	0.029	10	0.016	15	0.024	10	0.220	2	0.022	12
342	0.008	21	0.008	17	0.015	12	0.030	9	0.011	17	0.005	19	0.010	12	0.008	19
351	0.048	7	0.060	6	0.149	3	0.121	2	0.045	8	0.036	6	0.050	6	0.087	4
352	0.040	9	0.015	12	0.022	8	0.119	3	0.089	4	0.054	5	0.012	11	0.077	5
355	0.010	19	0.012	16	0.013	13	0.015	16	0.004	22	0.031	7	0.005	17	0.014	14
356	0.020	13	0.013	14	0.007	15	0.013	17	0.026	12	0.025	9	0.008	14	0.013	15
362	0.013	16	0.004	21	0.004	19	0.010	18	0.007	20	0.007	17	0.006	16	0.009	17
369	0.008	22	0.006	19	0.002	21	0.026	13	0.009	18	0.007	16	0.004	18	0.006	22
371	0.053	6	0.018	11	0.016	11	0.059	6	0.018	14	0.012	15	0.046	7	0.038	7
381	0.056	5	0.031	8	0.018	10	0.025	14	0.049	7	0.018	11	0.020	8	0.029	10
382	0.177	1	0.098	3	0.025	7	0.027	11	0.167	2	0.028	8	0.118	3	0.127	3
383	0.132	3	0.104	2	0.013	14	0.032	8	0.123	3	0.017	12	0.313	1	0.139	2
384	0.172	2	0.357	1	0.047	6	0.053	7	0.052	6	0.073	2	0.068	4	0.238	1
385	0.024	12	0.020	10	0.002	22	0.006	20	0.056	5	0.001	24	0.019	9	0.028	11
390	0.016	15	0.012	15	0.003	20	0.027	12	0.007	19	0.015	14	0.004	20	0.012	16

Table 9 (cont'd),

ISIC	greece	rank	india	rank	italy	rank	japan	rank	korea	rank	netherlands	rank	norway	rank	portugal	rank
311	0.156	1	0.063	5	0.034	9	0.002	17	0.006	16	0.108	3	0.087	5	0.031	11
313	0.018	13	0.001	24	0.013	19	0.000	23	0.001	22	0.013	14	0.001	22	0.024	12
314	0.019	12	0.001	21	0.000	24	0.000	22	0.000	24	0.019	12	0.000	24	0.002	24
321	0.151	2	0.206	1	0.070	4	0.016	9	0.091	4	0.025	11	0.016	13	0.122	3
322	0.120	3	0.144	3	0.044	8	0.001	19	0.021	7	0.013	13	0.003	19	0.078	4
323	0.007	19	0.026	12	0.023	15	0.000	21	0.011	13	0.002	24	0.003	20	0.003	22
324	0.003	22	0.018	13	0.029	13	0.000	24	0.005	17	0.004	22	0.001	23	0.065	5
331	0.005	21	0.001	23	0.006	23	0.001	20	0.001	23	0.005	20	0.027	11	0.048	8
332	0.003	23	0.001	22	0.032	12	0.001	18	0.002	20	0.005	19	0.027	12	0.014	16
341	0.014	15	0.004	18	0.017	18	0.005	13	0.012	11	0.027	8	0.080	6	0.059	6
342	0.008	18	0.002	20	0.008	21	0.002	16	0.002	21	0.008	18	0.006	16	0.002	23
351	0.072	5	0.091	4	0.055	5	0.065	5	0.085	5	0.122	2	0.092	4	0.043	9
352	0.068	6	0.047	6	0.045	7	0.021	7	0.007	15	0.057	7	0.029	10	0.020	13
355	0.006	20	0.010	15	0.011	20	0.012	11	0.011	12	0.008	17	0.003	21	0.013	17
356	0.014	14	0.007	17	0.018	17	0.004	15	0.007	14	0.012	15	0.013	14	0.010	19
362	0.002	24	0.004	19	0.007	22	0.006	12	0.003	18	0.004	23	0.003	18	0.010	18
369	0.045	8	0.015	14	0.027	14	0.005	14	0.003	19	0.005	21	0.004	17	0.014	15
371	0.033	10	0.043	7	0.033	10	0.032	6	0.045	6	0.025	10	0.063	7	0.018	14
381	0.030	11	0.034	10	0.054	6	0.017	8	0.020	8	0.027	9	0.049	8	0.036	10
382	0.067	7	0.041	8	0.212	1	0.211	3	0.189	2	0.237	1	0.170	1	0.054	7
383	0.092	4	0.033	11	0.080	3	0.262	1	0.292	1	0.104	4	0.115	3	0.152	2
384	0.045	9	0.035	9	0.126	2	0.247	2	0.159	3	0.091	5	0.162	2	0.166	1
385	0.010	17	0.007	16	0.022	16	0.074	4	0.013	10	0.067	6	0.042	9	0.009	20
390	0.011	16	0.165	2	0.033	11	0.015	10	0.014	9	0.011	16	0.006	15	0.006	21

Table 9 (cont'd),

ISIC	spain	rank	sweden	rank	turkey	rank	uk	rank	usa	rank	venezuela	rank
311	0.062	5	0.016	12	0.055	6	0.023	10	0.030	7	0.050	5
313	0.016	14	0.002	21	0.002	24	0.021	11	0.003	22	0.012	14
314	0.001	24	0.000	24	0.005	18	0.007	18	0.006	19	0.014	13
321	0.036	9	0.013	13	0.247	1	0.024	9	0.021	10	0.011	15
322	0.016	15	0.006	16	0.178	2	0.012	15	0.008	16	0.001	23
323	0.007	22	0.001	22	0.003	20	0.003	23	0.002	23	0.006	19
324	0.018	13	0.001	23	0.003	21	0.003	22	0.001	24	0.001	24
331	0.009	21	0.019	10	0.003	22	0.003	24	0.008	17	0.001	21
332	0.013	18	0.018	11	0.007	16	0.006	19	0.007	18	0.001	22
341	0.024	11	0.099	4	0.007	17	0.014	14	0.022	9	0.025	9
342	0.012	19	0.005	18	0.002	23	0.016	13	0.009	14	0.006	18
351	0.070	4	0.044	7	0.032	8	0.084	4	0.085	4	0.287	1
352	0.042	6	0.071	5	0.021	11	0.077	5	0.038	6	0.037	7
355	0.021	12	0.009	15	0.016	13	0.009	17	0.008	15	0.029	8
356	0.014	17	0.013	14	0.010	15	0.011	16	0.013	12	0.015	12
362	0.006	23	0.004	20	0.015	14	0.004	21	0.005	20	0.010	16
369	0.029	10	0.004	19	0.026	9	0.006	20	0.003	21	0.051	4
371	0.040	7	0.057	6	0.080	4	0.020	12	0.011	13	0.278	2
381	0.039	8	0.036	8	0.025	10	0.028	8	0.026	8	0.038	6
382	0.095	2	0.156	2	0.051	7	0.198	1	0.212	2	0.020	11
383	0.085	3	0.255	1	0.079	5	0.187	2	0.218	1	0.021	10
384	0.321	1	0.131	3	0.108	3	0.160	3	0.186	3	0.076	3
385	0.014	16	0.034	9	0.004	19	0.051	6	0.061	5	0.007	17
390	0.011	20	0.006	17	0.020	12	0.032	7	0.017	11	0.004	20

APPENDIX B

DATA DEFINITIONS

Number of employees: The number of persons engaged is defined as the total number of persons who worked in or for the establishment during the reference year. However, homeworkers are excluded. The concept covers working proprietors, active business partners and unpaid family workers as well as employees. The figures reported refer normally to the average number of persons engaged during the reference year, obtained as the sum of the "average number of employees" during the year and the total number of other persons engaged measured for a single period of the year. The number of employees is including all persons engaged other than working proprietors, active business partners and unpaid family workers.

Value added: The measure of value added normally reported is the census concept, which is defined as the value of census output less the value of census input, which covers:

(a) value of materials and supplies for production (including cost of all fuel and purchased electricity); and (b) cost of industrial services received (mainly payments for contract and commission work and repair and maintenance work). If input estimates are compiled on a "received" rather than on a "consumed"

basis, the result needs to be adjusted for the net change between the beginning and the end of the period in the value of stocks of materials, fuel and other supplies.

Total value added is the national accounting concept. It is ideally represented by the contribution of the establishments in each branch of activity to the gross domestic product. For the measure of total value added, the cost of non-industrial services is deducted from and the receipts for non-industrial services are added to census value added. The estimates, whether in terms of census value added or total value added, may be gross of depreciation and other provisions for capital consumption. The valuation may be in factor cost or in producers' prices, depending on the treatment of indirect taxes and subsidies.

Gross fixed capital formation refers to the value of purchases and own-account construction of fixed assets during the reference year less the value of corresponding sales. The fixed assets covered are those (whether new or used) with a productive life of one year or more. These assets, which are intended for the use of the establishment, include fixed assets made by the establishment's own labor force for its own use. Major additions, alterations and improvements to existing assets which extend their normal economic life or raise their productivity are also included.

New fixed assets include all those that have not been previously used in the country. Thus, newly imported fixed assets are considered new whether or not used before they were imported. Used fixed assets include all those that have been previously used within the country. Transactions in fixed assets include:

(a) land; (b) buildings, other construction and land improvements; (c) transport equipment; and (d) machinery and other equipment.

Assets acquired from others are valued at purchasers' prices, which cover all costs directly connected with the acquisition and installation of the items for use. In principle, assets produced on own accounts are also valued in this manner. However, it may frequently be necessary to value such own-account production at explicit cost, including any imputations that may be required in respect of the employed own-account labor. Assets produced by one establishment of a multi-establishment enterprise for the use of another establishment of the same enterprise should be valued by the receiving establishment as though purchased from outside the enterprise. Sales of assets should be valued at the actual amounts realized rather than at book values.

APPENDIX C

RESULTS IN DETAIL

Table 117: Malmquist index results

industrial countries	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Austria	1.149	1.102	1.002	1.056	0.958	1.036	1.030	0.889	0.823	0.894	1.317	0.956	1.034	1.388
Canada	1.051	1.111	0.942	1.111	0.983	0.995	0.941	0.779	1.04	0.919	1.231	1.187	0.941	0.758
Denmark	0.963	1.037	1.023	0.959	0.945	0.936	1.000	0.959	0.896	1.025	1.022	0.839	0.949	1.125
Finland	1.078	0.934	1.202	1.172	0.808	1.146	1.119	1.068	0.944	1.074	0.848	0.925	0.998	0.84
France	1.188	0.886	1.409	1.178	1.071	1.186	1.162	1.003	0.861	0.842	0.943	0.866	0.963	1.383
Germany	1.322	1.019	1.258	1.14	1.082	1.182	1.113	0.917	0.892	0.96	0.999	0.932	1.036	1.299
Greece	1.271	1.04	1.05	1.131	1.025	1.003	1.037	0.912	0.911	0.773	0.898	0.944	0.968	1.07
Italy	1.202	1.1	1.227	1.029	0.979	1.137	1.072	1.09	0.855	0.886	0.685	0.957	0.964	1.326
Japan	1.347	1.07	1.057	1.195	1.228	1.298	1.049	1.053	1.127	0.918	1.132	1.028	1.078	1.342
Netherlands	1.137	0.955	1.034	1.031	0.923	0.928	1.092	0.962	0.661	1.016	0.915	0.73	0.933	1.279
Norway	1.082	0.854	1.091	0.976	0.958	0.946	0.893	1.012	0.87	0.931	0.79	0.918	0.925	1.052
Portugal	1.139	0.757	0.891	1.118	0.938	0.982	1.170	1.065	0.634	0.804	0.812	0.765	1.25	1.386
Spain	1.114	0.983	0.956	0.855	1.01	1.471	1.129	0.942	0.715	0.972	0.817	0.726	0.979	1.459
Sweden	1.297	1.158	1.165	1.121	1.081	1.037	1.207	0.898	0.906	0.947	0.853	0.873	1.098	1.284
UK	1.052	1.049	0.903	0.915	1.069	1.044	1.032	0.938	0.828	0.881	0.91	0.875	1.02	1.156
USA	1.09	0.926	1.007	1.149	1.038	1.017	1.000	0.916	1.034	1.029	1.152	1.074	0.987	0.979
industrial countries mean	**1.157**	**0.993**	**1.071**	**1.071**	**1.006**	**1.084**	**1.061**	**0.962**	**0.874**	**0.923**	**0.952**	**0.912**	**1.007**	**1.161**
developing countries	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**
Chile	2.459	0.685	0.46	1.7	1.205	1.034	0.764	1.001	1.216	0.412	0.601	1.631	0.895	0.988
Colombia	0.968	1.823	1.148	0.695	1.275	0.966	0.91	0.785	0.814	0.886	0.701	1.214	0.836	0.983
Ecuador	1.258	1.02	1.029	0.859	0.948	0.932	1.143	0.882	1.007	0.551	1.12	0.851	0.894	0.606
Hungary	1.082	1.169	1.28	0.957	0.799	0.99	0.895	0.635	0.717	1.056	0.88	1.009	1.121	1.201
India	1.019	1.057	0.915	0.999	0.966	0.77	1.198	1.168	1.099	0.957	0.934	0.903	0.843	1.157
Korea	0.903	0.937	0.821	1.289	1.702	0.86	0.729	0.825	1.164	1.061	1.095	1.005	0.967	0.888
Poland	0.943	0.88	0.937	0.841	0.999	1.162	0.85	0.942	0.828	1.29	1.05	0.961	0.9	0.952
Turkey	1.011	0.939	1.126	1.13	0.893	0.826	1.059	0.696	1.089	0.95	0.959	0.756	0.903	1.168
Venezuela	1.296	1.929	0.771	1.062	0.972	0.784	0.751	1.211	1.244	1.075	0.725	0.555	1.329	1.242
Zimbabwe	1.296	0.732	1.003	0.959	0.861	0.852	1.162	1.013	1.031	0.841	1.298	0.865	0.646	1.06
developing countries mean	**1.215**	**1.139**	**0.933**	**1.059**	**1.064**	**0.924**	**0.922**	**0.905**	**1.019**	**0.905**	**0.896**	**0.987**	**0.965**	**1.02**
TOTAL MEAN	**1.158**	**1.017**	**1.008**	**1.048**	**1.015**	**1.009**	**1.01**	**0.935**	**0.917**	**0.903**	**0.932**	**0.918**	**0.971**	**1.108**

Table 1 (cont'd),

1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	mean
1.179	1.051	0.977	1.272	1.067	1.07	0.84	1.092	1.217	0.752	1.126	1.019	1.05	0.864	0.951	1.221	**1.036**
0.984	1.125	1.069	0.966	1.001	0.98	1.11	1.087	1.057	0.969	1.053	0.942	1.33	0.942	0.861	1.018	**1.009**
1.127	0.989	0.964	1.197	0.985	0.799	1.042	0.969	0.989	1.033	0.991	1.004	0.997	0.99	0.998	1.006	**0.989**
1.404	0.879	1.064	1.114	0.834	1.02	0.801	1.073	1.143	0.966	0.949	1.003	0.909	0.861	1.229	1.168	**1.009**
1.171	1.115	0.982	1.148	0.904	1.07	0.896	1.132	1.133	0.819	1.007	1.131	0.998	0.878	0.942	1.083	**1.035**
1.224	0.998	0.971	1.181	1.027	1.078	0.779	0.992	1.014	1.011	1.018	1.019	1.005	1.004	0.996	0.992	**1.042**
1.07	1.115	1.231	1.126	1.127	0.959	1.006	1.051	1.017	1.2	0.991	1.006	1.107	0.969	0.978	0.981	**1.027**
1.127	1.041	0.959	1.044	0.892	0.976	0.715	1.165	1.188	1.041	1.068	0.927	0.916	0.964	0.929	1.008	**1.006**
1.229	1.177	0.996	1.004	1.027	1.028	1.106	0.935	1.191	0.925	0.91	0.911	1.138	1.012	0.981	1.12	**1.08**
1.059	0.999	1.034	1.129	0.935	1.055	0.787	1.182	1.073	1.065	1.091	1.11	1.113	1.125	1.135	1.143	**1.012**
1.245	1.004	0.993	1.223	0.967	1.028	1.404	0.975	1.09	0.976	0.961	0.972	1.016	0.873	0.974	1.041	**0.995**
1.119	1.315	1.03	1.061	0.859	0.989	0.697	0.867	1.42	1.491	0.911	0.931	0.858	0.888	0.839	0.987	**0.978**
1.683	1.072	0.926	1.003	0.921	0.847	0.552	1.006	1.112	1.005	0.951	0.964	0.942	0.837	0.904	1.153	**0.978**
1.042	1.12	0.952	0.999	0.71	0.905	1.082	1.179	1.177	1.042	0.917	0.969	0.954	0.941	1.128	0.994	**1.026**
1.151	1.123	1.001	1.02	0.826	0.984	0.89	0.853	0.95	1.069	1.117	0.955	1.033	0.772	1.095	0.986	**0.978**
1.029	1.034	1.03	0.936	1.033	1.003	1.057	1.021	0.976	1.012	1.079	1.037	1.066	0.867	1.005	1.093	**1.021**
1.152	**1.072**	**1.011**	**1.068**	**0.941**	**0.966**	**0.92**	**1.026**	**1.109**	**1.02**	**1.008**	**0.993**	**1.024**	**0.924**	**0.996**	**1.062**	1.013
1987	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	
1.272	1.282	1.217	1.31	0.929	1.437	0.909	0.829	1.172	1.469	0.982	0.65	0.909	1.212	0.866	0.998	**1.013**
1.304	1.322	0.844	0.993	0.974	0.77	1.146	1.338	1.201	1.013	1.534	0.729	0.591	1.676	1.297	0.911	**1.017**
0.703	0.898	0.906	1.197	1.354	0.761	1.9	0.698	0.993	0.728	1.71	1.462	0.24	0.807	2.986	0.93	**0.956**
0.941	0.829	1.014	0.886	0.702	0.693	1.66	1.091	1.298	1.13	1.332	1.138	0.916	0.878	0.67	1.02	**0.975**
0.913	1.095	1.095	1.178	0.783	0.965	0.911	1.182	1.356	0.828	0.849	0.786	1.392	0.767	1.15	1.125	**0.999**
1.116	1.068	1.06	1.244	1.088	1.052	0.924	1.143	1.161	0.971	1.033	0.645	1.413	1.134	1.011	1.07	**1.028**
0.848	1.108	1.164	0.617	0.574	0.939	1.236	1.049	1.126	1.351	0.9	1.012	0.954	0.807	1.556	0.702	**0.962**
0.96	1.123	1.048	1.518	1.049	1.098	1.217	0.471	1.245	0.975	1.214	0.672	0.857	1.248	0.558	1.512	**0.979**
0.569	1.512	0.365	1.074	2.358	1.259	1.178	0.887	1.55	0.748	0.858	0.816	0.997	0.997	0.998	0.999	**1.002**
1.148	0.964	1.139	0.74	1.46	0.452	1.136	0.667	1.021	2.755	0.619	0.997	0.987	0.994	0.999	1	**0.971**
0.958	**1.127**	**0.968**	**1.113**	**1.09**	**0.997**	**1.231**	**0.965**	**1.233**	**1.023**	**1.156**	**0.878**	**0.908**	**1.038**	**1.232**	**1.029**	**0.99**
1.078	**1.082**	**0.983**	**1.068**	**0.978**	**0.951**	**1.002**	**0.977**	**1.141**	**1.045**	**1.026**	**0.938**	**0.95**	**0.959**	**1.027**	**1.04**	**1.004**

Table 2: Malmquist index and components means

	Malmquist	Efficiency ch.	Technical ch.	pure eff.	scale eff.
Japan	1.08	1.022	1.058	1.022	1.000
Germany	1.042	1.002	1.039	1.003	1.000
Austria	1.036	1.01	1.026	1.012	0.998
France	1.035	1.006	1.028	1.006	1.000
Greece	1.027	1.009	1.018	1.009	1.000
Sweden	1.026	1.000	1.026	1.000	1.000
Usa	1.021	1.000	1.021	1.000	1.000
Netherlands	1.012	1.017	0.995	1.019	0.998
Canada	1.009	0.998	1.011	0.998	1.000
Finland	1.009	1.005	1.005	1.005	0.999
Italy	1.006	0.991	1.015	0.991	1.000
Norway	0.995	1.01	0.985	1.01	1.000
Denmark	0.989	1.004	0.986	1.004	0.999
Portugal	0.978	0.997	0.981	0.997	1.000
Spain	0.978	0.993	0.984	0.994	0.999
Uk	0.978	0.989	0.988	0.990	1.000
Industrial countries mean	**1.013**	**1.003**	**1.01**	**1.003**	**1.000**
Korea	1.028	1.032	0.996	1.032	1.000
Colombia	1.017	1.021	0.995	1.021	1.000
Chile	1.013	1.017	0.997	1.023	0.994
Venezuela	1.002	1.013	0.989	1.013	1.000
India	0.999	1.007	0.991	1.017	0.99
Turkey	0.979	0.994	0.984	0.996	0.999
Hungary	0.975	0.995	0.980	0.996	1.000
Zimbabwe	0.971	0.982	0.989	1.009	0.973
Poland	0.962	0.976	0.985	0.979	0.997
Ecuador	0.956	0.975	0.981	1.000	0.975
developing countries mean	**0.99**	**1.002**	**0.997**	**1.008**	**0.993**
TOTAL MEAN	**1.004**	**1.002**	**0.988**	**1.006**	**0.997**

Table 3: Rank Correlations

All countries Malmquist productivity change rank correlation.				
		1st period	2nd period	3rd period
1st period	correlation coefficient	1.000**	0.238	-0.124
	p value	0.000	0.242	0.545
2nd period	correlation coefficient	0.238	1.000**	-0.418*
	p value	0.242	0.000	0.034
3rd period	correlation coefficient	-0.124	-0.418*	1.000**
	p value	0.545	0.034	0.000
All countries Efficiency change rank correlation.				
1st period	correlation coefficient	1.000**	0.088	-0.026
	p value	0.000	0.671	0.898
2nd period	correlation coefficient	0.088	1.000**	-0.393*
	p value	0.671	0.000	0.047
3rd period	correlation coefficient	-0.026	-0.393*	1.000**
	p value	0.898	0.047	0.000
All countries Technical change rank correlation.				
1st period	correlation coefficient	1.000**	0.555**	0.562**
	p value	0.000	0.003	0.003
2nd period	correlation coefficient	0.555**	1.000**	0.486*
	p value	0.003	0.000	0.012
3rd period	correlation coefficient	0.562**	0.486*	1.000**
	p value	0.003	0.012	0.000
Industrial countries Malmquist productivity change rank correlation.				
1st period	correlation coefficient	1.000**	0.156	0.003
	p value	0.000	0.564	0.991
2nd period	correlation coefficient	0.156	1.000**	-0.162
	p value	0.564	0.000	0.548
3rd period	correlation coefficient	0.003	-0.162	1.000**
	p value	0.991	0.548	0.000
Industrial countries Efficiency change rank correlation.				
1st period	correlation coefficient	1.000**	0.029	-0.133
	p value	0.000	0.914	0.624
2nd period	correlation coefficient	0.029	1.000**	-0.270
	p value	0.914	0.000	0.312
3rd period	correlation coefficient	-0.133	-0.270	1.000**
	p value	0.624	0.312	0.000
Industrial countries Technical change rank correlation.				
1st period	correlation coefficient	1.000**	0.605*	0.684**
	p value	0.000	0.013	0.004
2nd period	correlation coefficient	0.605*	1.000**	0.670**
	p value	0.013	0.000	0.004
3rd period	correlation coefficient	0.684**	0.670**	1.000**
	p value	0.004	0.004	0.000
Developing countries Malmquist productivity change rank correlation.				
1st period	correlation coefficient	1.000**	0.383	-0.204
	p value	0.000	0.275	0.571
2nd period	correlation coefficient	0.383	1.000**	-0.492
	p value	0.275	0.000	0.148
3rd period	correlation coefficient	-0.204	-0.492	1.000**
	p value	0.571	0.148	0.000
Developing countries Efficiency change rank correlation.				
1st period	correlation coefficient	1.000**	0.406	0.030
	p value	0.000	0.244	0.934
2nd period	correlation coefficient	0.406	1.000**	-0.333
	p value	0.244	0.000	0.347
3rd period	correlation coefficient	0.030	-0.333	1.000**
	p value	0.934	0.347	0.000
Developing countries Technical change rank correlation.				
1st period	correlation coefficient	1.000**	-0.101	-0.067
	p value	0.000	0.781	0.853
2nd period	correlation coefficient	-0.101	1.000**	0.110
	p value	0.781	0.000	0.763
3rd period	correlation coefficient	-0.067	0.110	1.000**
	p value	0.853	0.763	0.000

**Correlation is significant at the 0.01 level(2-tailed).* Correlation is significant at the 0.05 level(2-tailed).

Table 4: Equality of means for sub-periods of efficiency change (p values)

Industrial Countries	1st period -2nd period	2nd period -3rd period	1st period - 3rdperiod
Austria	0.816	0.144	0.240
Canada	0.903	0.669	0.581
Denmark	0.583	0.847	0.621
Finland	0.367	0.800	0.478
France	0.923	0.341	0.300
Germany	0.874	0.240	0.231
Greece	0.639	0.799	0.773
Italy	0.394	0.696	0.141
Japan	0.860	0.320	0.281
Netherlands	0.562	0.574	0.837
Norway	0.973	0.887	0.852
Portugal	0.504	0.442	0.872
Spain	0.681	0.415	0.199
Sweden	0.509	0.470	0.892
UK	0.711	0.465	0.347
USA	0.987	0.331	0.332
Industrial countries	**0.671**	**0.544**	**0.211**
Developing countries	**1st period -2nd period**	**2nd period -3rd period**	**1st period-3rd period**
Chile	0.900	0.176	0.489
Colombia	0.450	0.245	0.989
Ecuador	0.514	0.244	0.338
Hungary	0.424	0.729	0.724
India	0.244	0.453	0.918
Korea	0.757	0.823	0.679
Poland	0.295	0.181	0.753
Turkey	0.722	0.652	0.829
Venezuela	0.852	0.621	0.351
Zimbabwe	0.671	0.495	0.634
Developing countries	**0.639**	**0.333**	**0.510**

Table 5: Equality of means for sub-periods of technical change (p values)

Industrial Countries	1st period -2nd period	2nd period -3rd period	1st period -3rd period
Austria	0.276	0.497	0.532
Canada	0.333	0.871	0.420
Denmark	0.435	0.859	0.471
Finland	0.825	0.780	0.949
France	0.452	0.948	0.488
Germany	0.497	0.594	0.283
Greece	0.065	0.175	0.387
Italy	0.535	0.537	0.316
Japan	0.336	0.442	0.109
Netherlands	0.438	0.439	0.244
Norway	0.444	0.960	0.447
Portugal	0.442	0.888	0.451
Spain	0.365	0.664	0.484
Sweden	0.233	0.789	0.157
UK	0.393	0.991	0.392
USA	0.867	0.865	0.992
Industrial countries	**0.778**	**0.632**	**0.611**
Developing countries	**1st period -2nd period**	**2nd period -3rd period**	**1st period -3rd period**
Chile	0.199	0.666	0.570
Colombia	0.365	0.682	0.375
Ecuador	0.620	0.997	0.636
Hungary	0.436	0.647	0.572
India	0.235	0.640	0.615
Korea	0.306	0.739	0.243
Poland	0.447	0.883	0.426
Turkey	0.388	0.686	0.505
Venezuela	0.402	0.550	0.322
Zimbabwe	0.366	0.945	0.500
Developing countries	**0.341**	**0.559**	**0.400**

Table 6: Malmquist index and components

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Industrial														
malmquist	1.157	0.993	1.071	1.071	1.006	1.084	1.061	0.962	0.874	0.923	0.952	0.912	1.007	1.161
Efficiency ch.	0.995	1.191	1.072	0.966	0.972	1.081	1.089	1.105	0.832	1.074	0.864	0.858	1.04	1.25
Technical ch.	1.168	0.85	1.002	1.107	1.034	1.002	0.978	0.895	1.052	0.931	1.106	1.06	0.969	0.956
developing														
malmquist	1.215	1.139	0.933	1.059	1.064	0.924	0.922	0.905	1.019	0.905	0.896	0.987	0.965	1.02
Efficiency ch.	1.004	1.486	0.917	1.072	1.033	0.948	1.018	1.061	0.976	1.078	0.88	0.943	0.987	1.102
Technical ch.	1.221	0.744	1.032	0.972	1.03	0.967	0.93	0.862	1.048	0.841	1.059	1.032	0.946	0.929

Table 6 (cont'd),

1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	mean
1.152	1.072	1.011	1.068	0.941	0.966	0.92	1.026	1.109	1.02	1.008	0.993	1.024	0.924	0.996	1.062	**1.013**
1.079	1.007	1.013	1.129	0.923	1.001	0.817	1.041	1.079	1.005	0.962	0.98	0.986	1.022	1.021	0.981	**1.003**
1.091	1.064	0.998	0.965	1.023	0.98	1.056	0.994	1.028	1.016	1.049	1.015	1.031	0.904	0.977	1.081	**1.010**
0.958	1.127	0.968	1.113	1.09	0.997	1.231	0.965	1.233	1.023	1.156	0.878	0.908	1.038	1.232	1.029	**0.990**
0.825	1.063	1.056	1.09	1.142	0.916	1.09	1.03	1.116	0.959	1.086	1.045	1.045	1.011	1.197	0.991	**1.002**
1.179	1.052	0.939	0.989	0.983	1.039	0.985	0.971	1.087	1.236	1.013	0.862	0.899	1.049	1.021	1.036	**0.988**